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AND

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BRITISH FOUNDRYMEN'S ASSOCIATION.

Notice to Members.

The second annual Convention of the members of the British Foundrymen's Association will be held in the New Lecture Halls of the Glasgow and West of Scotland Technical College, Andersonian Buildings, 204, George Street, Glasgow, on Monday, Tuesday, and Wednesday, August 7, 8, and 9, 1905.

The programme is as follows:—

Monday, August 7.

9.30 a.m.—In the Small Lecture Hall. Open to members only. Secretary's report. Vote of thanks to retiring officers. Election of officers for ensuing year.

10.15 a.m.—Public meeting in the Large Lecture Hall. Presidential address by Mr. Robert Buchanan.

11 a.m.—Address by Professor Sexton, F.I.C., F.C.S., on "Technical Education and the Foundry."

11.30 a.m.—Paper, "Cast Iron," by Mr. Herbert Pilkington, C.E., M.I.M.E., Vice-President.

12.30.—Interval for lunch.

2 p.m.—Visit to Carron Works (members only). Time of train to be announced. Members must present their card of membership.

Tuesday, August 8.

9.30 a.m.—Paper, "Moulding Sands and Fireclays," by Mr. Percy Longmuir, metallurgist and Carnegie medallist, etc.

10.15 a.m.—Paper, "The Microscope and Pig-iron," by Mr. A. Campion, F.I.C., F.C.S., Carnegie gold medallist.

11.0 a.m.—Paper, "Profitable Founding," by Mr. John G. Stewart, Urmston.

Discussion invited on all the papers.

12.30.—Interval for lunch.

2.0 p.m.—Visit to the Steel Works, Newton, and Glenfield Works, Kilmarnock (members only).

Wednesday, August 9.

9.0 a.m.—Excursions and visits to other works will be arranged, notice of which will be given at the meetings. A number of micro-sections of metals will be shown in the laboratory, and descriptions given by the assistants in the college. This has been kindly arranged by Professor Sexton. A large number of photo-micrographs, illustrating the structure of various metals will be shown. These have been kindly lent by A. H. Hiorns, Esq., Principal of the Metallurgical Department, Birmingham Municipal Technical School.

The headquarters of the Council are the North British Station Hotel, George Square.

Other hotels—Windsor Hotel, St. Vincent Street; Central Station Hotel, Gordon Street; Grand Hotel, Sauchiehall Street; and Waverley Hotel.

Terms of membership, 7s. 6d. per annum. Application to—

F. W. FINCH,
Secretary.

Kingston House,
Lansdown Road, Gloucester.

—o—

SPECIFICATIONS FOR FOUNDRY IRON.

THE world is accustomed from day to day to hear a great deal about the development of the steel industry. Much less is known by the man in the street as to the progress of the foundry industry. And yet the ironfounder consumes a larger quantity of iron than any other branch of metallurgical business, except the steel manufacturer. In Germany it is known that the consumption of foundry iron is close on two million tons a year. In our own country the same branch of the iron trade calls for well over a million and three-quarter tons of pig-iron annually. In the United States the production of foundry iron in 1903 was over 4,400,000 tons. Three countries alone, therefore, consume more than eight million tons of pig-iron annually in iron foundries. This is, of course, apart from the very largely and rapidly increasing consumption of Bessemer and basic iron in the manufacture of steel castings.

It is not a little remarkable that in this immense branch of the iron industry much still remains to be done in order to secure that scientific precision and co-ordination of practice and theory which is now so generally found to regulate the conditions that prevail in the steel trade. Over a very large area of foundry operations it is still the custom to test pig-iron for foundry purposes by fracture alone. In other words, the human eye is left to determine whether a particular iron is suited for a particular purpose on which issues of the greatest moment may hang. If all human eyes were alike at the same time this practice might perhaps be more tolerable. But no organ of the human body is more liable to differ in different men than the eye, which is not the same in sickness as in health, which is notoriously liable to defects in the judging of colours, and which may to-day be clear and accurate and to-morrow may be blurred and "fishy." The test by fracture is the least scientific of all tests, and the practice of ironfounders will never reach the highest scientific precision until it has been got rid of. Attempts have been made of late years to substitute analysis for fracture as a much more scientific measure of character and quality. In the United States analysis is now very largely applied, but in this country rule-of-thumb dies hard, and this particular example of it the hardest of all, because it appears to be so convenient and to give so little trouble.

One of the reasons for the slow progress of analytic standards in this country is that even when analysis is accepted instead of fracture, pig-iron makers are not always prepared to guarantee it. Another is that the same analysis that is suitable for one description of casting is by no means well suited to another. Hence, in drawing up specifications for the analyses to which foundry irons should be required to conform, it is probable that hardly any two should be exactly alike. This fact has long been recognised in the United States, where several associations of foundrymen have attempted, with more or less success, to tackle the problem. We hope that in our own country the recently-formed British Foundrymen's Association will not be found lacking in kindred enterprise. The Committee of the London Metal Exchange, which has undertaken the consideration of the subject of foundry irons, has already led the way by adopting four different grades with varying proportions of silicon, sulphur, and phosphorus. There is, however, much work still to be done, and in doing it carefully and well British founders will be rendering a signal service, not to themselves alone, but to the trade generally.

BRITAIN'S EARLIEST IRON FURNACES AND MOULDING FLOORS.

By Thos. May, F.S.A. (Scot.)

(*Continued from page* 281.)

Refining or Smithy Furnace No. I.

This, shown in Figs. 6 and 7, was situated inside the fortifications at Wilderspool at less than 80 yards from the smelting furnace No. 1, close to the foundations of a solidly constructed building gable-ended to the west Via, from which there was a paved corridor or alley leading to it. Though the trades of iron manufacturer and blacksmith at the present day are usually separate ones, the division of labour in Roman times was not so complete, and the crude or cast iron from the smelting furnaces was not only refined and rendered malleable in this ancient ferraria (so named from the material ferrum, iron), but also welded into useful forms upon the spot. From its size it will be perceived that the operations were on a diminutive scale, and the method employed an extremely simple one.

The hearth itself was a roughly semicircular stage or platform, built up of broken tiles and bricks in five courses, set in stiff boulder clay with wide joints for mortar, and enclosing a cylindrical pit or crucible (catinus), the interior of which was lined with calcined clay. Dimensions:—Platform, length (diameter), 3 ft. 6 in.; width (radius), 2 ft. 6 in.; vertical height, 1 ft. 10 in. to 2 ft. 2 in.; fire-seat or crucible, diameter 11 in., depth 9 in.

From the base of the crucible a funnel, 6 in. wide at the top and 2 in. at the bottom, lined with broken tiles, extended downwards 7 in., and opened into the front of the hearth by a narrow gap 2½ in. wide between the tiles. This appears to have been the tap-hole for running out the cinder or scoria.

A semicircular floor of clay 2 ft. 6 in. in diameter and 2 or 3 in. thick lay in front of the hearth at 1 ft. 8 in. below its summit, and a yellow powdery layer of burnt soil surrounded both floor and platform.

In front of the clay floor there was a deposit of unspent charcoal in lumps, showing the original grain of the wood. A few bits of cannel coal were also met with.

Only one lump of heavy slag was found in the immediate vicinity of the furnace, but there was a deposit of light "cinder" (silicate of iron) outside the south-east angle of the adjoining house, at 35 ft. south from the furnace; and in the wall of the crucible, underneath the calcined lining, there was a small globule of glassy "cinder," the analysis of which is given below (No. 3), indicating that the refining of iron was the purpose for which the furnace was used. There was also a block of cast iron (about 2 in. by 1 in. by 1 in.), the analysis of which is also given below (No. 1).

Fig. 6.—Iron Purifying Furnace or Smithy Hearth at Wilderspool.

Two coins, a first bronze of Domitian and a second bronze of Trajan, were found along the edge of the long wall adjoining, at 1 ft. 3 in. and 1 ft. 6 in. from the surface respectively.

No fewer than 60 iron nails of various sizes were found in a rubbish pit opened out at a distance of 45 ft. nearly in a direct line south from the furnace.

The most interesting find close to the furnace was an iron tube about 8 in. in length, $1\frac{1}{8}$ in. external and $\frac{5}{8}$ in. internal diameter, $\frac{1}{4}$ in. thick, hollow inside, but coated on the outside with a thick concretion of sand and rust. The tube itself is too much oxidised for analysis. It appears to have been the nozzle of the bellows for working the crucible, and was probably introduced over the top.

The analysis of three specimens of iron and slag from the crucible furnace I by Mr. Ruddock gave the following results :—

(1) A squarish block of iron (about 2 by 1½ by 1in.), coated with scale.

Carbon, combined	0.230
Carbon, as graphite	3.0
Silicon	1.050
Sulphur	0.485
Phosphorus	0.756
Manganese	0 403
Iron, by difference	94.076

This he described as a sample of cast iron, extremely brittle, smelted with coal from an impure ore, probably spathic, owing to the high phosphorus; and with a sulphurous coal, owing to the remarkably high sulphur.

(2) A piece of wrought iron resembling a cotter or lynch pin.

Carbon	0.090
Silicon	0.060
Sulphur	0.031
Phosphorus	0.257
Manganese	trace
Iron, by difference	99.562

The high proportion of phosphorus led him to conclude that it was produced from an impure ore, and that it was probably made from cast iron and not direct from the ore.

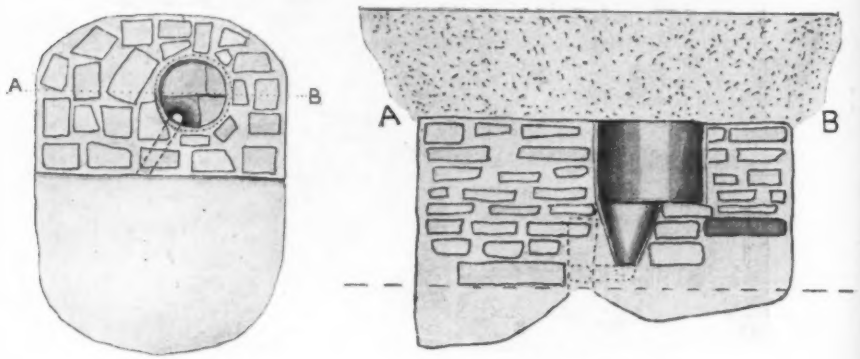
(3) A small gobule of cinder from the wall of the furnace, underneath the calcined lining.

Silica	73.800
Ferrous oxide	17.5
Ferric Oxide	1.2
Alumina	1.7
Magnesia	0 55
Phosphoric acid	0 724
Sulphuric acid	1.650
Alkalies, etc.	2.876

Such a slag as this, he inferred, would be obtained by reducing an ore containing appreciable quantities of phosphorus and sulphur.

Ore-roasting Ovens I. and II.

On one side of a cobble-stone causeway in front of the very solid foundations of a building with veranda gable-ended to the



PLAN. SECTION.

FIG. 7.

main Via at Stockton Heath, an oblong platform of clay hardened by burning extended 18 ft. from east to west by 12 ft., and was continued 6 ft. further eastward by rough rubble pitching. On its west end were three L-shaped depressions (like punch marks on the end of a railway ticket), with continuous floors and connected cavities. The middle cavity was evidenced to be an ore-roasting oven by a nodule of clay-band iron ore, splintered and reddened by heat, retained by a hole in the middle of the hearth at its west end, and by several others in a like condition lying round about (these may be seen at the Museum).

Its long arm was 6 ft. 3 in. from east to west by 10 in. to 1 ft. 3 in.; short arm, 1 ft. 8 in. by 1 ft. 3 in. Its depth varied

from 3½ in. to 4 in., with a slight fall towards the outlets and a basin-shaped depression at the angle between the arms. The broken edges of an overarched cover were traced along the sides, and its fragments filled up the interior.

The remaining cavities were shallow troughs of about half the length (2 ft. 6 in. and 3 ft. 6 in. respectively), and 6 in. to 1 ft. 4 in. wide. That on the left had one opening towards the front of the platform and the other to the middle of the long arm of the oven just described, from which it was divided by a strip of burnt clay forming a sort of bridge. That on the right opened the opposite way, with the lip of one mouth to that of the short arm of the oven, and the other mouth towards the south, away from it. The slopes and connections were arranged on a plan to enable the ore to be raked into towards the openings, and in the angle, and a calcined nodule of clay-band iron ore embedded in the bottom likewise showed it to be the base of an ore-roasting oven.

Midway between the two ovens and bedded to the top in a clay floor of uncertain extent at 1 ft. 9 in. below the grass level lay a large stone mortar, doubtless for crushing the calcined ore, its dimensions being 2 ft. 2 in. by 1 ft. 9 in. by 11 in. thick, outside measurement, with an oval hollow 10 in. to 11 in. across and 7 in. deep, rounded at the bottom and worn smooth by pounding. This is rather smaller than the similar mortar unearthed in 1902 described above.

Ore-roasting Ovens III. and IV.

A pair of long oval furnaces, Figs. 4, 5 (July issue) and 8, existed partly under-

FIG. 8.—PAIR OF SUPPOSED ORE FURNACES, WILDERSPOOL, NEAR WARRINGTON.

and out of the oven without removing the fire, and to allow continuous working. There was a hearth of flag-stones in front of the stoke-hole of the oven, and an ash-blackened layer of soil surrounding the platform.

Thirteen feet south from the preceding and in line with it, at a depth of 3 ft. 9 in. below the grass, and underneath a flag pavement and two clay floors of secondary construction (still unexplored), there was another oblong platform of clay of smaller dimensions, 8 ft. 6 in. from east to west by 3 ft. 10 in., enclosing a similar L-shaped cavity of the following dimensions:—

Long arm, 5 ft. 6 in. by 1 ft. 6 in.; short arm, 1 ft. 2 in. by 9½ in. to 1 ft. (turned southward). The depth increased in the same manner from 4½ to 6½ in. neath the north-west corner of the smelting hearth II. Their dimensions were:—

II.—Length, 2 ft. 6 in.; breadth, 1 ft. 6 in.; depth, 1 ft. Fire-hole: Length, 1 ft.; breadth, from 1 ft. to 1 ft. 8 in.

III.—Length, 2 ft. 8 in.; breadth, 1 ft. 4 in.; depth, 10 in. Fire-hole: Length, 8 in.; breadth from 10 in. to 1 ft. 6 in.

Symmetrically laid in front of both their openings there was a semicircular hearth of hard-baked clay, ornamented all over with rings, 1¾ in. outside diameter, stamped evenly without intersecting on the surface of the soft clay previously to baking. These ovens were only 1 ft. 2 in. apart in the same clay platform, which was found 2 ft. below the grass.

From their shape and position, and from

the mass of hematite ore (referred to above) embedded in the clay, it may be inferred that they were used for roasting or calcining the ore previous to smelting in the smelting hearth II. erected above.

Further evidence of the intended purpose of this group of furnaces, and of their early date—1st to 5th century—was afforded by a deposit 9 ft. across of black glossy cinder, found on examination of samples by Mr. Ruddock, to be essentially silicate of iron, or slag produced by iron smelting, which was situated at the north-west angle of the clay floor, and by the ash-blackened stratum surrounding the contents of the latter. Lumps of hematite, ruddle, clay-band iron ore and slag were scattered here and there, and were also found intermixed with lumps of mineral coal in the bottom of a water-channel or drain and beneath its stone, pitching over against a bronze-founder's workshop closely adjoining and to be described in my next article. Four samples of the slag were analysed by Mr. Ruddock to determine whether copper was smelted from the ore in this locality or brought there in a metallic state. The results were:—

	1.	2.	3.	4.
Ferrous oxide	29.75	53.65	63.15	17.00
Ferric oxide	23.81	10.03	8.56	1.52
Alumina	2.27	1.97	2.15	.60
Lime and magnesia ...	2.72	1.65	1.40	—
Phosphoric acid	.30	.73	.43	.64
Moisture and inorganic matter	1.00	1.30	1.50	—
Insoluble residue (silicate of alumina)	39.72	27.95	21.20	80.42
	99.97	97.28	98.30	99.98

They are certified to be iron furnace slags with no trace of copper or copper smelting.

Mineral coal is also well known to have been in general use throughout the Roman encampments along the line of the walls of Hadrian and Antonius, and elsewhere. It was certainly employed at Wilderspool for iron smelting, notwithstanding the oft-repeated assertion that "charcoal was the only fuel used in smelting till 1618, when Lord Dudley introduced coal for this purpose." The fragments of cannel coal found in all parts at Wilderspool have been collected and deposited along with the other relics in the Warrington Museum.

Low down in the bottom of the beforementioned water channel, beside a large fragment of bronze crucible, there were five large pieces of cannel and one of ordinary mineral coal, the position of which was carefully noted to afford satisfactory evidence of its use as fuel by the Romans. This has now been sufficiently established by the evidence of competent authorities in twelve different localities, viz.:—

At Manchester (Mancunium) a large buried store was found close to the issue of the Roman road from the eastern gate. ("Whitaker's Hist.," p. 80, and Rœder's "Roman Manchester," pp. 151, 159.)

At Chester (Deva), in excavations near the gas works, Mr. Shrubsole found fragments, chiefly cannel of good quality, associated with Roman remains. ("Jl. Arch. and Hist. Soc.," N.S. Vol. I., p. 77.)

At Bath (Aquæ Sulis) it is referred to by Solinus as being employed to maintain perpetual fires in the Temple of Minerva, about the 3rd century A.D. "In cujus Æde perpetui ignes nunquam canescunt in favillas, sed ubi ignis tabuit, vertit in globos saxeos," Solini Polyhist., c. 22. (Mon. Brit. Hist.)

At Wroxeter (Uriconium), "coal, in its mineral as well as in its burnt condition, was found lying adjacent to and within some of the hypocausts." (Wright's "Uriconium," pp. 55, 115, 159; "Jl. Brit. Arch. Assoc.," Vol. XVI., p. 34.)

At Caerwent (Venta Silurum), Monmouthshire, "there was evidence in many places of the use of coal in Roman times, and numerous small cubes, probably from the Forest of Dean coalfield, were found in several of the Roman houses." (A. T. Martin, M.A., F.S.A., and Alfred E. Hudd, F.S.A., "Archæologia," Vol. LVII.)

In several stations per lineam Valli its discovery has been recorded:—At Housesteads (Borcovicus), excavated in 1883, nearly a cartload was found in the guard chamber of the southern section of the east gateway. Dr. Bruce's "Guide to the Roman Wall," ed. 1863, p. 119.)

At Cærvoran (Magna), in digging up some of the foundations in 1762, coal cinders, some very large, were turned up. (Wallis, "Hist. of Northumberland," Vol. I., p. 119.)

In excavating the Mucklebank wall turret during 1891, a piece of coal was found under circumstances which showed that the Romans must have worked some of the outcropping seams of coal not uncommon in the district. ("Arch. Æliana," Vol. XXIV., p. 16.)

At Great Chesters (Æsica) a small quantity was found. (Ibid., p. 48.)

According to Dr. Bruce, "In several places the source whence the mineral coal was procured can be pointed out." ("Roman Wall," 2nd ed., p. 433.)

In the Roman villas at Great Witcombe, "several large pieces of pit coal were

found." ("Archæologia," Vol. XIX., p. 183.)

At Spoonley Villa, near the Roman coal mine, in the Forest of Dean, it appeared to have been used to heat the hypocaust furnaces. (Prof. J. H. Middleton, F.S.A., "Archæologia," Vol. LII., Part 2, p. 651.)

In his account of the Roman buildings at Woodchester, p. 12, Lysons states that a considerable quantity of coal ashes was discovered.

At South Shields "a quantity of coal has been noticed in the station; it usually lies deep down, so that it cannot have been placed there after the departure of the Romans." ("Archæologia," Vol. XLVI., p. 170.)

The foregoing details of (1) the construction and surroundings of three different kinds of furnaces, viz., ore-roasting ovens, melting hearths, and crucible or refining hearths; (2) two kinds of fuel, cannel coal and ordinary mineral coal in the former, and charcoal in the latter, for the manufacture of iron; (3) the results of analysis of specimens of ore, slag, cinder, crude or cast iron, and finished iron derived from these furnaces; and (4) the opinion of an expert in regard to them, are strong evidence in support of the view that an indirect method of producing crude or cast iron in one furnace, and re-heating it with charcoal to convert it into pure or malleable iron in another, was practised in this locality.

FIG. 9.—IRON SMELTING FURNACE FOR IMPURE ORES. ILLUSTRATION TAKEN FROM AGRICOLA.

The earliest writer upon the subject, Pliny, speaks of a method of hardening iron by quenching in water, and of the use of oil for the same purpose. A 16th century writer, Georgius Agricola, "De Re Metallica," lib. ix., p. 337-339, gives a very clear description of two separate furnaces, the melting hearth (rinnherd), and the crucible hearth (schmidherd), for iron smelting. The latter was used in the production of soft malleable iron or "blooms" direct from the purer ores by a single heat, with charcoal for fuel, in conjunction with a forced draught by bellows and a tilt-hammer, both driven by a water-wheel. The hearth was 3½ ft. high, 5 ft. long and broad, in the middle of which was a crucible (catinus) 1 ft. high and 1½ ft. wide, the dimensions, however, varying according to the requirements. The crucible appears to have been lined with powdered charcoal (two parts), powdered earth (one part), mixed together and moistened with water, and then beaten down with a pile or rammer in such a way as to form a circular cavity 1 ft. wide 8 in. deep. Ore and charcoal in alternate layers were heaped up and the fire lighted inside the crucible, combustion being forced by means of a tube introduced over its edge connected with bellows (Fig. 9).

Impure ores not only underwent a preliminary process of roasting, washing, and powdering, but were actually melted by prolonged heating in a much larger furnace before being removed to the crucible furnace for refining with charcoal and welding into blooms. Agricola's description of the process is sufficiently brief and explicit to be quoted *in extenso* (the translation being my own):—

"More labour and a fiercer heat are requisite for cuprous or refractory ore, since the portion containing the metal has not only to be divided from the rest and disintegrated with dry stamps, but it must also be roasted to sublimate other metals and noxious salts, and washed to separate the lighter portions. It is to be smelted in a furnace similar to the first (shaft furnace), but much larger and loftier, to contain much more ore and charcoal, and to be charged alternately with ore in fragments no larger than a nut and with charcoal, which are thrown in by the smelters, who ascend the steps on one side of the furnace. From such ore, sometimes once, sometimes twice, roasted, iron is melted suitable for being re-heated in the smithy furnace, and beaten out be-

neath that great iron hammer, and cut into pieces with a sharp edge."

By means of these discoveries and researches the following facts have been ascertained as to the mode of working practised by the early iron manufacturers in the locality:—

(1) The composition of the slags varied from about 80 per cent. of silicate of alumina and other impurities and 20 per cent. of oxides of iron to about 75 per cent. of the latter and 25 of impurities.

(2) The small proportion of lime present in the slags shows that it was merely an accidental impurity, and was not added intentionally as a flux.

(3) The quantity of alumina in the slag and a large number of specimens prove that clay-band ores were principally used.

(4) Pure silica in the form of pounded white quartz pebbles appears to have been added as a flux (for the hematite ores), the black glassy specimens of slag when pounded being found under the microscope to contain a large proportion of these white particles, with occasional lumps half an inch in diameter.

(5) Mineral coal, principally cannel, was employed as well as charcoal or dry wood for smelting, many pieces of cannel being collected in the Roman stratum and deposited in the Museum, as well as smoothing tools or burnishers of the same material, and its use as fuel having been demonstrated in more than a dozen other Roman settlements.

(6) The "follis fabrilis," or blacksmith's bellows, resembling our own, and other artificial methods of forcing combustion were in use here as in other localities.

The Romans are well known to have employed bellows, conical ducts, and other artificial modes of creating a blast in their furnaces.

Sir William Fairbairn, in his work on "Iron, its History, etc," p. 7, points out that "whenever the blast was sufficiently powerful the iron would be fused, and a partial carburation would take place. The resulting metal would undergo a rude process of refining, by which the metal was again heated with charcoal and the blast directed over its surface, so that the carbon would be burned out and the iron become tough and malleable. These two processes, he considers, might form two successive stages of one operation, as at present practised with the Catalan forge." The Wilderspool discoveries prove that this is what actually took place.

Dr. R. W. Raymond has been elected an honorary member of the Institution of Mining and Metallurgy.

COST KEEPING FOR THE FOUNDRY.*

By R. W. M'Dowell.

In a paper of this kind it would be useless to describe a system of cost finding for any special line of foundry business as such a paper would be of interest to

Form 5

ORDER NO. _____

DATE _____

EMPLOYEE NO. _____

ARTICLE _____

_____

OPERATION _____

DATE		IN	OUT	IN	OUT	TOTAL
1-16						
2-17						
3-18						
4-19						
5-20						
6-21						
7-22						
8-23						
9-24						
10-25						
11-26						
12-27						
13-28						
14-29						
15-30						
31						

TOTAL HOURS. _____ MIN. _____

RATE _____

AMOUNT _____

Form No. 5.

only those whose foundries are devoted to that particular class of work. Therefore it will be attempted to outline a system of a general nature only, showing the main features of foundry cost accounting in as plain and simple a manner as possible. The subject of foundry cost

* A paper read before the American Foundrymen's Association.

keeping has become of far greater interest to foundrymen than formerly, owing partly to the vast improvements that have been made in foundry methods and appliances, making it necessary to keep the methods in the office up to the standard of those in the foundry, but due to a greater extent to the keen competition of recent years which has made it necessary for the foundryman to know just what his product is costing and how to reduce this cost if possible. The only way that he can obtain this information is through an accurate and reliable system of cost records, the rough estimates that served the purpose in former years being practically worthless.

A cost keeping system for a foundry is neither as difficult to handle nor as complicated as might be imagined. Like the cost accounting for any other line of manufacturing business, it is based on four main elements of expense—namely; Material, labour, factory expense, including such items as lubricating oil, maintenance of machinery, flasks, etc., and general expense, including taxes, insurance, etc. The system should be gotten up with a view to obtaining these items with accuracy and with little trouble. It should be arranged to run in harmony with the general accounting system, being, in fact, a part of the latter. Special columns should be provided in the books of original entry to take care of the various items mentioned above, from which they may be obtained for the cost sheet. It is better to figure costs by the month, and not to attempt daily costs, as it is manifestly impossible to obtain the various items of expense, outside of material and labour, daily. These may, however, be obtained monthly direct from the general account books.

In operating a cost system one can do no better than to follow the rule given

DAILY CUPOLA REPORT.

Date Feb. 15. 1904 No. 38

Kind of Iron	Pile No.	No. lbs.	Per C.	Ck.
Pig. No. 1	24	10980	17	
Pig. No. 2	31	21110	33⅞	
Pig. No.				
New Scrap Grade A	7	18191	28	
New Scrap Grade				
Machine Scrap	11	4215	06½	
Shop Scrap		819	01¼	
Bad Castings, Heat of 2/13/05		2060	03⅛	
		57378	88⅛	
Remelt, Heat of		7622	11¾	
Total Iron to Cupola		65000	100	

Coke 8130
Flux 560
Blast on 12:50 Off 4:50 Time of Heat 4 hours
No. lbs. iron melted per bu. lbs. coke 799

Good Castings	51680	Total Iron Melted	65000
Bad Castings	1947	Deduct Result of Heat	61739
Remelt	8112	Melting Loss	3261
Total	61739	Per cent	.05

Remarks:

Form 1

FORM NO. 1.

in an article on manufacturing accounts by Kenneth Falconer. It is as follows:—"The keystone of factory accounting is a rigid adherence to the rule that no work shall be put in hand, expenditure incurred, or goods or material delivered without written authority emanating from the office, and that all papers and records referring to or reporting such work must bear the number of the order authorising the same." This may be adapted to any line of cost accounting.

Form 2

IRON REPORT FOR MONTH OF _____ 190____

Kind and Grade of Iron	Weight	Total	Perct.	Price	Amount
Pig No. 1	27 4 5 6 0		16⅓		
Pig No. 2	5 3 2 1 8 0		31⅜		
Pig No.					
Scrap, Grade A	3 1 9 4 6 8		19⅛		
Scrap, Grade B	1 6 3 1 9 4		09⅞		
Machine Scrap	1 1 2 1 3 9		07		
Total New Iron		1401541	83⅜		
Shop Scrap	1 9 6 6 3		01¼		
Bad Castings	5 2 8 9 4	72557	03½		
Total		1474098	87⅓		
Add Remelt		196842	12⅔		
Total Iron to Cupola		1670940	100		
Cost of Iron					
Coke	205870				
Flux	11910				
Total					
Good Castings	1258960				
Bad Castings Deduct	51614				
Remelt	197346				
Whole Results	1507920	1507920			
Loss		163020	09¾		
Net Cost of Iron					
Cost of Coke, Flux, etc.					
Whole Cost					

FORM NO. 2.

Material.

Iron being the most important item of the material used, the reporting of it will first be considered. Each day's heat is reported on a blank similar to Form 1. This report may, if so desired, be arranged to show the amount of each charge by arranging a column for each kind of iron and leaving a line for each charge. These reports should be made up with care, and measures should be taken to see that they are accurate at all times. A monthly report, Form 2, is made up from the daily reports, showing the total quantity of iron used during the month, together with the costs. Coke and flux are also included in this report.

Sand and similar materials are reported daily on a slip like Form 3. A method of checking these slips should be provided so as to insure accuracy. Moulding and core sand should be brought in on trucks of large capacity, each truck load being weighed as it passes over the scales. Other materials which are of convenient bulk for keeping in the store-room are obtained by means of requisitions. The ideal method of keeping track of material would be to keep it all in the store-room and not allow it to go out without a requisition having first been given for it, but in the case of iron, coke, sand, etc., it

DAILY MATERIAL REPORT

Date _____ No. _____

Kind of Material	Quantity	Check
No. lbs. Molding Sand		
No. lbs. Core Sand		
No. lbs. Facing		
No. lbs. Flour		
No. lbs. Chaplets		
No. lbs. Fire Clay		
No. Gals. Linseed Oil		
No. Gals. Core Compound		
No. Gals. Molasses		
No. Quarts Carbon Oil		
Sundries		

_____ Foreman

FORM NO. 3.

would be impossible, so that the only method possible is to report them correctly.

Stock records should be kept, and whenever any material runs low an inventory of it should be taken and the stock record checked with it. Besides proving the records this saves a great deal of time at the close of the year, as it will not be necessary to take a full inventory of all materials. A convenient form of stock record is shown in Form 4.

Form 4

RECORD OF MATERIAL No.

Name of Material Where kept.

Received				Used				Balance	
Date	Order	Amount	Total	Date	Order or Req.	Amount	Total	Date	Amount

FORM NO. 4.

desired period. The illustration shows a card gotten up for bi-monthly pays. The time of moulders working on piece work is taken from the production sheet, Form 6. The exact arrangement of this sheet will depend largely upon the classification of the product, but the form shown gives a good idea of about what will be required. It may be made up from cards turned in by the moulders, or a report may be made up daily by the time-keeper or factory clerk going from floor to floor and taking down the name, number, pattern, and number up of each moulder. This is entered on the production sheet, and the sheet made up in as many copies as required. It is completed when the weighmaster's copy giving the result of the heat comes into the office.

PRODUCTION SHEET FOR _____ 190 _____

Names	Nos.	Name of Casting	Pattern	Order	No. Up	Bad	Good	Wt. Up	Wt. Bad	Wt. Good	Cs.	Pcs.	Classification

FORM NO. 6.

Labour.

The next expense item is the labour. There are a number of methods of keeping track of the labour in a foundry, all of which have their own advantages, and it depends largely on what proportion of the labour is paid for by the day and what by the piece as to what method should be employed. But in the opinion of the writer the best method is found in the use of one of the modern time recorders. The time of each man is thus kept on a card similar to Form 5 for any

PAY-ROLL FOR HALF MONTH ENDING _____ 190 _____

Department _____

Names of Employes	Nos.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		Hours	Pcs.	Rate	Day Work	Pc. Work	Pcs.	Non Pcs.	Total	Deduct.	Amount Due.

FORM NO. 7.

The time book or pay roll is shown in Form 7. This is arranged in very much the usual manner, with the exception of the provision which is made for separating productive and non-productive labour

for convenience in figuring costs. When the plant is arranged by departments, one or more pages of this book may be allowed for each department.

be omitted in making up the cost sheet. A shop order is issued monthly for keeping track of all repairs, all material and labour used for this purpose being charged

PURCHASES FOR MONTH OF _____ 190 _____

	Supplies	Iron	Equipment	Labor	General Expense	Patterns	Factory Accounts: Expense	Repair	General	General	Fol.	Name	Fol.	Accounts Payable

FORM NO. 8.

Factory and General Expense—The Cost Sheet.

Special columns for recording factory and general expense should be run in the journal, cash books, and purchase book or voucher record of the regular account books. In this way all expenses incurred up against this order. A page of the purchase book is shown in Form 8, showing the arrangement of the special columns. In case of the plant being divided into departments, columns are allowed for each department also.

The cost sheet is shown in Form 9.

Cost Sheet for month of _____ 190 _____

Expense Items	Cost	Extension	Total	Last Mo.	Differ.
Iron					
Coke					
Flux					
Molding Sand					
Core Sand					
Linseed Oil					
Other Material					
Sundries					
Total Material					
Productive Labor					
Non-productive Labor					
Repairs					
Factory Expense					
General Expense					
Fuel and Light					
Foremans Wages					
Net Cost Production					
Patterns					
Office Expense					
Freight					
Special					
Total Cost of operating					
Good Castings					
Machine Work					
Sundry Jobs					
Total					
Deduct Cost					
Profit					

FORM NO 9.

during the month are classified in the regular books, and are in the most convenient form for posting to either the main ledgers or the cost sheet, and it is thus assured that no expense items will

Material other than iron is obtained from the "used" division of the stock records and figured at cost value. The cost of iron is transferred from the monthly iron report. Productive and non-productive

labour are then obtained from the pay roll, and then come factory expense, general expense, fuel and light and sundry expense, taken from the special columns in the regular books, and repairs as shown by the shop order. The total of these items gives the net cost of production. To this total is added freight, office expense, patterns and special expense, giving the whole cost of operating for the month. It is customary with some foundries to charge up the expense of producing patterns against the cost of the regular product, but the belief of the writer is that they should be treated in the same manner as machinery or any other equipment, for the reason that they are not an actual factor in the cost of getting out the product any more than the cupola is. One would hardly charge up the cost of the cupola against the cost of the first month's production, and it is scarcely more reasonable to charge up expensive patterns against the cost of production of the month in which they were made, when these same patterns will be used for many other months to come, in a great many cases, and if such items are included a false cost per pound of the finished product is the result. Therefore a distinction should be made between the cost of production and the cost of operating for a given time, and patterns should be included in the latter division, but not in the first.

If so desired, the sheet may be arranged according to departments, and this arrangement is desirable in a large plant, but it is not so shown in the illustration, as this is intended to illustrate a general system.

The forms shown here are intended to represent and illustrate the simplest possible forms and methods of foundry cost accounting, and, of course, would have to be modified considerably for the requirements of any special line of foundry work. In this form, however, they are more easily adapted to the needs of anyone wishing to design and operate a system on these lines.

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MESSRS. WILLANS & ROBINSON have recently obtained some remarkable results from the special qualities of steel they are now making at their Queen's Ferry Works. Steel recently supplied for hollow axles for large motor-car firms have given the following results under test :—Yield point, 63.25 tons; maximum strength, 70.51 tons; ratio, .89; contraction of area, 33.75 per cent.; elongation per cent. in 2 in., 15.5 per cent.; impact, 9.1 ft.-lbs.

VENTING OF CORES.*

BY JAS. A. MURPHY.

THE proper venting of cores has been a theme upon which foundrymen could base interesting argument. Bad venting has always furnished a ready-made excuse for a bad casting by the moulder; indeed when he could think of nothing else to lay the blame on, the core was sure to come in for a bad character and the coremaker's ability was designated with suitable and expressive adjectives.

Not all moulders recognise the degree of skill that is required to vent some crooked cores properly, nor do all coremakers realise how necessary it is to have vents through which the gas will flow easily and without any unnecessary obstruction.

The evolution of the air compressor, gas engine and automobile has set the brightest minds in the business experimenting, seeking a remedy for the poorly vented cores that cause such disturbances at casting time. The proper venting of this class of cores is a far more skilful operation than most people are ready to allow, and it is only seldom that the coremaker has the proper facilities to do the job properly. The core shop is the most neglected part of our foundries to-day, and it is only within a few years that it has been noticed at all. It is a hopeful sign of the times, however, to see foremen and employers in general waking up to its necessities and its possibilities.

The pulling of wires and soaped strings around corners as a means of venting is a thing of the past. The wax wire method of venting has come into our foundries to stay. All methods of wax wire venting are not by any means satisfactory.

The wax taper with a string of threads running through it gives very poor satisfaction, that with the wire through it is better, but its cost is an item of no small consideration, and many foundries prefer to do without it, and continue to lose castings on this account. The object of using the wax, of course, is that the core while drying absorbs the wax, leaving only the string of wire which, when pulled out, leaves an open and free hole.

If the string gets burned on the end it is a difficult job to pull it, and if it breaks inside the core it cannot be extracted. An imperfect vent is the result, and a possible blown casting.

The wax wires, Fig. 1, are the result of much experiment to do away with

* Read at the New York meeting (June, 1905), of the American Foundrymen's Association.

strings of any kind in the wax; in fact, to have something that was as nearly foolproof as possible.

The element of cost was also a consideration, and the composition used is made at less than one-eighth of the cost of any

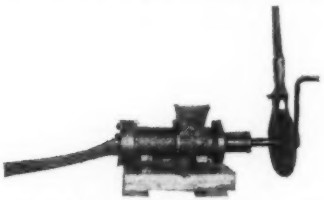

FIG. 1.—PRESS WITH WAX WIRES BEING FORCED OUT.

wax on the market to-day. The illustration of the machine, Fig. 1, gives a fair idea of the process of manufacture. A helper will turn out enough of different sizes in about one hour to last 30 coremakers one day, so the cost of manufacture is infinitesimal, once the installation is made.

These wires are easy to handle, are not sticky except when hot, are as tough as twine when at the right temperature, and can be made in coils of any length or cut off in desirable lengths, and laid away in trays ready for instant use. There is no waste, as the pieces not used, short ends, etc., are again put back in the machine and pressed out as new wires.

The thickness is regulated by the die. In practice I make them from 3-32 to $\frac{3}{8}$ in., but any desired size can be made. The material is very light, and I have known men not to use a pound all day venting the most complicated jacket cores for air cylinders.

The skill of the core-maker is considerably minimised in producing a perfectly vented core, as it is impossible for him to do otherwise if he rams up a string of

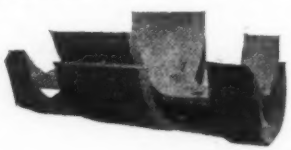

FIG. 2.—JACKET CORES VENTED WITH WAX WIRES.

this wax in the proper parts of the core. It is not claimed that this wax will take the place of rods, but its absorption by the sand in baking has a very decided tendency to strengthen the core.

Several cores that must be made in halves in order to be properly vented can be made in one piece by this process at a considerable saving of time and expense.

Since I designed this machine and brought this method of venting cores to what I consider a state of absolute perfection, in the shops of the Chicago Pneumatic Tool Company, blown cores are a thing unknown in our foundry, where every casting is filled with them and where work of the most intricate character is the rule rather than the exception.

I cannot lay too much stress upon the time-saving qualities of this machine. Venting is at best a tedious and time-killing operation no matter how it is done, but with this wax all that is necessary is to ram up the string in the proper place and the job is done permanently and well.

The ingenuity of the most expert designer in producing crooked orifices for which cores must be employed in the pro-

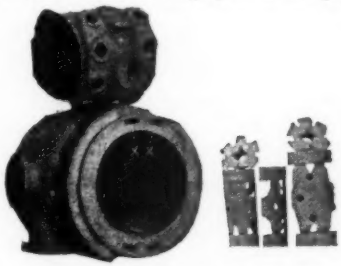

FIG. 3.—CYLINDERS AND CORES. THE PHOTOGRAPH REDUCES THE CORE MORE THAN THE CYLINDER. THE VENT IS ALL TAKEN THROUGH XX.

duction of the casting is defied, for as long as there is left any opening through which a small pipe can be passed a perfectly vented core can be made by this process.

Several foundrymen who have seen the process in operation have pronounced it one of the most important inventions for the cheap and safe production of intricate work.

Its cost of installation being very small, the cost of the material not worth mentioning, no waste material, the accessibility of all sizes of strings in any quantity at a moment's notice, and the perfection of the cores that it is used in, are all points very much in its favour of being later as universally adopted as the core making machine.

I consider it absolutely indispensable in shops which make a speciality of pump, engine, air compressor, gas engine, automobile or other intricate or delicate work.

FOUNDRY AND PATTERN SHOP STANDARDS.*

By Wm. H. Parry.

It is an old maxim that moulders and pattern-makers never agree as to the means each should employ to facilitate the work of the other.

That this state of affairs will always exist, in spite of the well-meaning action of societies in appointing standardising committees, cannot be denied, but by this very action a much better basis of understanding can be brought about. The conditions which surround each of the interested parties will be better known, and thus a start in the right direction made.

When we speak of standardising everything in foundry and pattern shop, it is not to be by means of hard and fast rules, for this is bound to fail, because of the constantly varying conditions along these lines of mechanical endeavour. Much, however, can be done by the observance of the fundamental principles that govern a fair proportion of the work accomplished in both departments of the industry.

In loam work it is often found that a wide divergence of opinion exists on many points pertaining to that branch of the foundry trade. Chief of these may be mentioned the proper angle of the sides of in-and-outside seats, their depth, and the diameter of spindles used. Some foundrymen insist on having sweeps made for seat plates, such that for every inch of depth, one-eighth inch angle must be allowed. This certainly shows good results. Other foundrymen, however, insist on having but one-sixteenth inch for this purpose. Still others demand three-sixteenths of an inch, and the severely technical foundry superintendents are still abroad who require their angle given in degrees and minutes. Yea, sometimes even in seconds.

Now this is all very pretty, but unfortunately it adds to the already chaotic conditions of the shop. The author has suggested that from an all around experience of many years, one-eighth of an inch is about the proper angle.

Next we have the old controversy of the depth of core and outside seat. The ratios differ from one inch in depth of seat to one foot in height of casting, regardless of diameter: to one-half inch of depth to one foot of height This can easily be settled by simple formulæ which suggest themselves, and have been in successful use for some years. For instance, with the diameter D, and the height H, the formula

$$\frac{D+H}{2}=Y$$

is applicable for castings approximately equal as to height and diameter, and

$$\frac{D+H}{4}=Z$$

is applicable where the diameter is twice the height. It can readily be seen that sufficient area of contact is given to insure rigidity and proper alignment.

The diameter of loam spindles are rarely the same in any two jobbing foundries, often varying from one and one-half to four inches in diameter; and to suit these deplorable conditions sweeps are made by the pattern-maker to the centre line, with the understanding that the foundryman will trim them to suit the size of the spindle. It works fairly well for a time, though it increases the foundry cost and offers a fine field for incorrect work for the first moulder, not to speak of the next one who tackles the job, and whose spindle is a little larger or a little smaller than the one used by the first man.

It may be difficult to standardise matters here, but at least to evoke discussion it is suggested that for castings whose diameter and height do not exceed five feet, a two inch spindle should be used. Over five and under ten feet, use a three inch spindle; over ten and under fifteen feet, a four inch spindle, or some sort of an arrangement of this kind which will give the pattern-maker a line on which to work, so that he can make his sweeps and loose pieces accordingly, and not thrust work upon the foundryman which should be done in the pattern shop in the first place.

The question of draft has undoubtedly been a bone of contention from the very beginning of the art of making patterns and casting metals. It does seem that an agreement can be reached between the disciples of both trades, if a proper spirit is manifested. If the spirit of give and take be manifested, a rule can surely be agreed upon, such for instance that one degree of draft be always allowed for drag and cheek, and never less than three degrees for cope. What an advance there would be in the right direction if this were an accomplished fact, to say nothing of the clearing of the atmosphere about the foundry when such things as back

* Paper read before the American Foundrymen's Association.

draft, no draft, or very little draft come up for ventilation.

The angle of the sides of core prints is a point worthy of our serious discussion, as there are but few foundries and pattern shops wherein there is an agreement on that matter. For all around work this angle varies from five to fifteen degrees a side. In this age of core-making machines there seems to be a peculiarly opportune time to make a stand for what in the estimation of the members of the American Foundrymen's Association, is the right angle for all core prints, whether they are small enough to make on the machine, or big enough to be made by strickles. The angle should be determined for all time.

The moulding machine has come to stay, and to keep up with the procession, the size of flasks to be used on standard makes is, and is going to be, a serious problem for the pattern-maker who has to fit up work for different styles of machines, whose flask sizes differ as well. There should be standard flask sizes, such as 10 in. by 10 in., 12 in. by 12 in., 12 in. by 18 in., 12 in. by 24 in., etc., etc. By this arrangement patterns could be fitted up in one city and cast in another. The fitting up of patterns at the foundry would be obviated whereas this must now be done on account of the many manufacturers of moulding machines.

Mechanical engineers, who decorate their drawings with mandatory orders to cast *off* this, or two *of* this, or sometimes two *as* this, apparently need a little help in the ordering of castings. So why not simplify the matter by using symbols, to which they are proverbially prone, say such as Ct 2, and thus destroy at one fell swoop the everlasting controversy whether it is two off, of, or as. Again, if two castings are to be made from the same pattern, so made that by the transposition of a loose piece or two, it makes right hand or left hand work, they might, instead of the usual instructions to Cast One Right and One Left, use the same symbols, Ct 2 R & L, or Ct 1P, which, being interpreted, means Cast One Pair. In this way less time is consumed in writing orders for castings, and an understanding is also reached between foundry and pattern shop.

The varnishing of patterns so that prints show a contrasting colour, and spots sometimes occupied by loose pieces also show still another contrasting colour, is, so far as the pattern shop is concerned, a very pretty way of decorating a pattern. The trouble is, that after making a few castings, all colours look alike, and it has happened that a loose piece has been forgotten here and there, and consequently costly castings have been returned minus these protuberances, all because the moulder of the pattern may have been colour-blind. If, instead of contrasting colours, the prints are stamped *Print*, loose pieces, and the spaces they belong to, stamped L. P. , L. P. , L. P. , L. P. ; and finished surfaces F. F. F., care being taken never to use the latter F to designate a loose piece; it will be found that better castings result with less pattern shop expense.

There are many other practices that could be improved upon by standardising, and it is to be hoped that pattern-makers and foundrymen alike will cast their prejudices aside and thus make possible for both to dwell in harmony in the future. For this purpose I respectfully request that a committee be appointed by this Association to study the standardising of pattern shop and foundry practices, and report recommendations from time to time to this body.

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TRAINING FOR THE FOUNDRY.

Mr. W. C. Bruce writes:—A foundry school must have a general line of castings to make, so that when the apprentice is turned out he will have a general knowledge of the business and be able to command wages as a practical moulder or core maker. In an ordinary apprenticeship, as it is now carried on, there is no one to give the boy any special instructions, and if he makes a mechanic at all, it is because of his superior natural qualifications along that line. There is no question in my mind but that we could get plenty of young men who would be very glad of an opportunity to learn a business or trade that pays as good wages as the average moulder can make, provided he did not have to serve an unreasonable time to do so. I believe that one year's experience in the proper school with the proper instructions would be equal to the present four years' course in the average foundry, and, in fact, six weeks for an ordinary intelligent man should be sufficient for him to learn to turn out good work on 75 per cent. of the work that is made in the ordinary foundry.

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The gross value of the estate of the late Mr. C. Wallis, of Peter Wright & Son, Oldbury and Dudley, has been returned at £24,880.

THE CUPOLA SYSTEM OF THE MICHIGAN STOVE COMPANY.*

By W. J. Keep.

In describing this plant and the performance of the cupolas and blower, it is with the full realisation that ideal conditions seldom exist, and that each man must fashion according to his needs. An independent blowing unit for each cupola with short piping is an arrangement we would like to have, but which only a favoured few possess.

In our case the piping from the blower has been extended to meet the growth and increased demands of our plant until now we have three cupolas operated by one blower, under the following conditions: Starting at the blower end is a No. 7½ Roots blower, running at 150 revolutions per minute. From there the air piping is carried overhead by two 90-degree bends in a 28-in. line 72 ft. to a point where it branches with a Y into two 24-in. lines, one running 248 ft. to cupola No. 3; the other 104 ft. to cupola No. 1. From No. 1 with a Y branch begins a 16-in. line running 210 ft. to No. 2 cupola. All bends are of long radius and the wind boxes are supplied by two pipes on opposite sides, starting from a Y on the main line. The sketch shows the general location of the pipe lines and cupolas.

There are butterfly valves in line at cupolas Nos. 1 and 3, so that cupola No. 2 may not be short of wind, and they are also opened to allow surplus air to escape when cupola No. 2 is operated alone. No. 3 is the point where the least air is needed, and is where most of the throttling down occurs, because this cupola serves a snap flask shop, which cannot take care of the iron as fast as the normal operation of the cupola would furnish it. As No. 3 cupola seldom operates over two hours, and with a very small heat, it is run at a disadvantage and cuts down the average efficiency of the entire plant.

In most of the data the results are for the plant as a whole, and while this shows unfavourably for Nos. 1 and 2, it represents the actual working conditions liable to occur in almost any large plant. We find that our best results are obtained with a blast pressure at the cupola of from 16 to 18 ounces, for we get our fastest melting under those conditions, without sacrificing economy of operation. In order not to exceed 18 ounces a relief valve is placed at the blower to lift at that pressure. We have tried higher pressures, and have found that with from 22 to 26 ounces there was no increase in the melting rate, as the chilling effect of excess air nullified the advantage of increased blast pressure. Up to 22 ounces

No.2 Cupola uses 6710 coke.
61550 lbs. of iron.
Time wind on 2 hours 50 min.
Melting ratio 9.17 to 1.
Coke bed 1200 lbs.
Sand bottom to tuyers 18"
Melts 10¾" tons per hour.
No.2 Cupola 72"outside
5¼ inch lining.
Blast pressure 15 oz.
635 feet of pipe in all.
2-90° bends in 28"pipe.
3-45° " " 28" "
4-45° " " 20" "
6 long bends in 16"pipes.
4 Y forks.
Charge for each cupola.
1st charge on coke bed 1800 lbs. iron.
All other charges 3000 " "
All coke charges 200 lbs.
Total iron melted 81 tons 50 lbs.
Melting ratio for the three cupolas 9.62 to 1.
Fire lighted. 12 M.
Wind on.....9 P.M.
Iron down.....3-15 P.M.
Every ladle of iron hot.
No.1 Cupola 80"outside.
5½ inch lining 1602 pressure. 16
7300 lbs. coke 67225 iron.
Time wind on 2 hours 25 minutes.
Melting ratio 9.21 to 1.
Coke bed 2000 lbs.
Sand bed to tuyers 19"
Melts nearly 1¼ tons per hour.
Drops 15 ft. Pressure 1009
No.3 Cupola 72"outside
9"lining-16 oz. pressure.
3955 coke-33305 iron.
Time 2 hours-10 minutes.
Melting ratio 8.42 to 1.
Coke bed 1500 lbs.
Sand bed to tuyers 12"
Melts 7¾ tons per hour.
All used by bench moulders who cannot use iron any faster.
As wind is off each cupola, valves are set to make 16 oz. on * 8.
Rise of 15 feet to top of brick wall
30x51½ Roots Positive Blower 150 R.P.M.
Relief valve set for 16 oz. pressure
210 feet of 16" pipe
104 feet of 16" pipe
248 feet of 24" pipe
72 feet of 28" pipe
Blower and short line shaft average 6¼ horse power during melt.

there was a decided increase of output, but the best results were with a blast of 16 or 18 ounces.

The losses from friction in the piping are ½ ounce to No. 3, ¾ ounce to No. 1, and 1½ ounces to No. 2. At the beginning of the heat only Nos. 1 and 2 are on

* A paper read before the American Foundrymen's Association, New York, June, 1905.

Later No. 3 is started up and the pressure falls as low as 14 ounces at No. 2. This condition does not last for more than half an hour, when the pressure runs up to 15 ounces at No. 2 and 16 ounces at Nos. 1 and 3, at the end of the heat, with the dampers, this cupola getting 16½ ounces and melting very fast. The following is the record of an 81-ton heat in the fall of 1904, when the foundry was running to its full capacity.

An 81-Ton Heat in 1904.

Cupola.	Outside diameter. Inches.	Inside diameter. Inches.	Coke used. Pounds.	Iron melted. Pounds.	Ratio iron to coke.	Length of heat.	Tons melted per hr.
No. 1...	80	68	7,300	67,225	9.21 to 1	2h. 25m.	14
No. 2...	72	60	6,710	61,450	9.17 to 1	2h. 50m.	10½
No. 3...	72	53	3,955	33,305	8.42 to 1	2h. 10m.	7¾

Totals, 81 tons 50 pounds iron; 32.75 tons per hour. Ratio 9.2 to 1. Air displaced by blower per ton per hour 22,800 cubic feet.

For stove plate it requires close attention to avoid dull iron when the ratio is above 9 to 1, and the following are average records. When more coke is burned melting is slower:

A 75½-Ton Heat in February, 1905.

Cupola.	Coke used. Pounds.	Iron melted. Pounds.	Ratio.	Length of heat.
No. 1 ...	6,900	63,430	9.0 to 1	2h. 55m.
No. 2 ...	6,450	59,250	9.2 to 1	2h. 55m.
No. 3 ...	3,640	28,270	7.8 to 1	1h. 50m.

Total, 75 tons 950 pounds iron. Ratio, 8.86 to 1. Air, 25,380 cubic feet.

1905.	March 1.	March 2.	March 3.
Total coke used ...	16,950 lbs.	16,970 lbs.	16,660 lbs.
Total iron melted	75 tons. 10 lbs.	74 tons. 1,740 lbs.	73 tons. 190 lbs.
Ratio iron to coke	8.8 to 1	8.8 to 1	8.7 to 1
Tons melted per hour	23.8	23.07	28
Cubic feet of air per ton per hour	25,500	26,400	26,400

On March 8, 1905, on account of a funeral of one of the employés, No. 1 cupola was run alone with an air pressure of 17 ounces. The moulders could not pour fast enough to take the iron as fast as melted, and it was, therefore, necessary to reduce the blast at times. Under these conditions 33 tons 960 pounds of iron were melted at the rate of 13.4 tons per hour, with a ratio of 9.2 to 1. As the average of the last four heats in No. 1 cupola was 11 tons per hour, the increasing of the blast 1½ ounces has increased the melting 20 per cent.

Horse-Power Required to Drive the Blower at Various Pressures.

Pressure at blower.	Indicated horse-power to drive blower.	Theoretical horse-power to drive blower.	Per cent. efficiency of blower.	Friction
13 ounces	50	45.23	93.1	6.9
18 ounces	72	62.48	92.0	8.0
23 ounces	87	80.00	87.0	13.0

The engine was indicated by an expert. A pressure of 18 ounces at the blower would produce the normal pressure at each cupola. The friction of a short countershaft and belt are included in these figures. As the relief valves of our blower are set for 18 ounces and our pressure varies from 13 to 18 ounces, it is fair to assume 64 as the average horse-power consumed during one melt. As the tonnage with three cupolas is 28½, the horse-power per hour required under our conditions is 64 + 28½ = 2.25, and the air displacement per ton of iron per hour is 26,220 cubic feet per hour, instead of 30,000 cubic feet, as usually allowed.

As a pound of carbon requires about 11 pounds of air for combustion to CO^2 and 13 cubic feet of air equals 1 pound, therefore 1 pound of coke should require 143 cubic feet of air. The coke averages about 5,650 pounds, requiring theoretically 28,500 cubic feet of air per hour.

Wishing to know what the makers would recommend for our work as the most economical installation, we find, in spite of our long pipes, and air actually wasted, when Nos. 3 and 1 are shut down, that we are still well within what would be ordinarily expected in an ideal arrangement of independent blowers and motors for each cupola, with consequent decrease of pipe friction. The makers recommend as follows:

Cupola blown.	Cubic feet air displacement per minute.	Horse-power.	Tons.
No. 1 ...	7,000	30.5	14
No. 2 ...	5,400	23.5	10¾
No. 3 ...	4,000	17.5	7¾
Total ...	16,400	71.5	32¾

Allowing 20 per cent. for friction of blower and motor we get 90 horse-power, or 2¾ horse-power per ton, against 2¼ actually required. On the above basis of air the friction losses figure out 1 ounce to No. 1 cupola, 3.1 ounces to No. 3, and 6 ounces to No. 2. On an allowance of 24,000 cubic feet per hour per ton of iron the friction to No. 1 cupola is 0.9 ounce, to No. 3 0.55 ounce, and to No. 2 cupola 2.50 ounces.

The actual loss, as stated before, is from ½ to ¾ ounce to Nos. 1 and 3. It is from

1¼ to 1½ ounces to No. 2, showing that our piping is of correct size to Nos. 1 and 3, but too small to No. 2. It would be better to continue the 28-inch pipe to the fork at No. 1 and make it 20 or 24 inch to No. 2.

The data presented here represent as near as possible actual running conditions, and our plant could be improved upon by independent units for each cupola with shorter piping, thus avoiding the waste of air when Nos. 1 and 3 are down. This could be done by reducing the speed of the blower, but as we are fixed we have to use constant speed. However, as we are now getting iron as hot and as fast as we wish it, there is no object in increasing the blast pressure.

We would be very much interested to have the records from a plant where the arrangement is similar to ours, and where a fan is used instead of a rotary blower.

———o———

Messrs. J. W. Jackman & Company, Limited, of 39, Victoria Street, S.W., agents for the Pridmore moulding machine, inform us that Mr. H. E. Pridmore, the maker of these moulding machines, advises them that the International Harvester Company, of Chicago, have recently started to manufacture gas engines, and have placed an order for forty Pridmore moulding machines, which are to be fitted with patterns for moulding all the castings used in the construction of these engines.

In connection with the system of spraying water, with the object of cooling it, a great number of plants are successfully at work in various parts of the country, in which the Simplex Spraying Nozzle, invented by Messrs. Gjers & Harrison, of Middlesbrough, is the means employed for breaking up the hot water into spray and so cooling it. There are seven plants at present under construction to deal with 126,000, 100,000, 70,000, 35,000, 21,000, 9,000, and 6,500 gallons of water per hour.

An association representative of British manufacturers and traders interested in export business is now being formed under the name of the Manufacturers' Association of Great Britain. Its objects will be to promote and expand trade (in this case British trade) in foreign and Colonial markets. A trade index to British manufacturers is to be compiled in the chief commercial languages of the world and distributed free to Chambers of Commerce, large merchants, and others, in the Colonies and foreign markets.

HOT BLAST CUPOLAS.

To the Editor of the Foundry Trade Journal.

Sir,—In your issue of April, I notice a description of Higham's hot blast cupola recently patented, and, by the way, would remark that this is another illustration of the absurdity of the English Patent Law, seeing that a patent should be granted for a similar claim to more than one person. To further explain, I enclose a sectional view of my cupola, for which a patent was granted me.

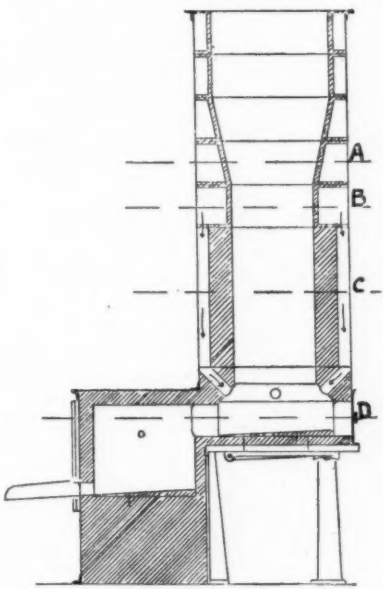

Fig. 1.—Littleton's Cupola (Section through E. Fig 2.)

The outer form and construction generally is of the ordinary kind, the casing is of stout steel plates, and receiver when applied is so arranged as to reduce the distance or length of throat forming the connection of cupola to receiver.

The inner part or lining is of a special form composed of two parts, the upper and lower. The upper part is formed of a series of cast iron segments extending from the charging level to the top of fire brick lining. The lower part of the C.I. lining for two sections is specially arranged as an air belt through which the blast from the blower is forced, making

about two complete turns before entering the vertical passages communicating with the tuyeres. The result is that the blast is heated considerably before it enters the tuyeres.

The lower part of lining is formed of the ordinary fire brick and clay materials, and extends from a point just above the

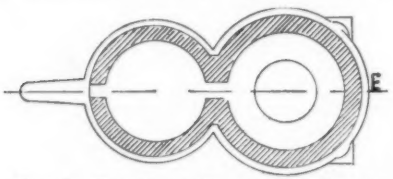

FIG. 2.—SECTIONAL PLAN AT D. FIG. 1.

melting zone down to the hearth or bed of furnace. The cross section area is increased at a point where the tuyeres enter the interior of furnace.

My object, however, in writing you, is not to enter into a controversy on the Patent Law, but to give you particulars of results obtained with my heated blast cupolas, and which, I think, are considerably in advance of the figures given by Mr. Higham.

Mr. Higham gives the temperature of blast entering the tuyeres as 212 degrees; this, I consider, is very low, and I have frequently, at an early stage of the blow, obtained 400-500 degrees F. The possibility of this will be readily understood when the position of air belt in my cupola is compared with Mr. Higham's.

In either case, the results given are only such as are obtained in ordinary practice.

I have frequently melted small beats of 2 or 3 tons per hour with less than 10 per cent. of coke, and blows of two or more hours with 7 per cent., including bed—without bed, less than 5 per cent., and give below particulars of a heat run with a No. 2 patent heated blast cupola:—

	1. Coke. lbs.	2. Iron. lbs.	3. Coke. lbs.	4. Coke. lbs.	5. Coke. lbs.
Bed charge...	196	—	—	196	—
1st iron ...	—	560	—	—	—
2nd Coke ...	50	—	50	50	50
2nd iron ...	—	672	—	—	—
3rd coke ...	50	—	50	50	50
3rd iron ...	—	784	—	—	—
4th coke ...	50	—	50	50	50
4th iron ...	—	896	—	—	—
5th coke ...	40*	—	40	—	—
5th iron ...	—	1,008	—	—	—
6th coke ...	40*	—	40	—	—
6th iron ...	—	1,003	—	—	—
	426	4,923	230	346	150
	p. c's.		p. ct.	p. ct.	p. ct.
Proportion	8.		4.67	7.	3.04

Column 1 gives total coke charges; 2, total iron; 3, minus bed coke; 4, minus old coke; 5, minus bed and old coke.

* NOTE.—The two charges of 40 lbs. each was the coke remaining from the previous blow—about this amount remains after every blow—and is therefore coke not actually used, so it should not be charged.

This heat was run in 65 mins. with 16 w.g. air pressure, and is at the rate of 2,676 lbs. iron melted per square foot area of cupola per hour.

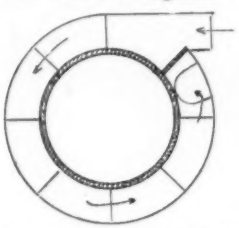

FIG. 3.—SECTIONAL PLAN AT A.

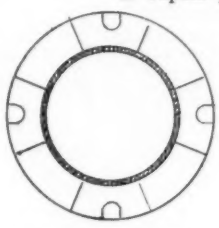

FIG. 4.—SECTIONAL PLAN AT B.

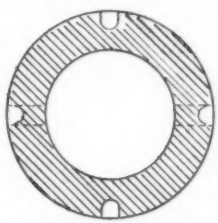

FIG. 5.—SECTIONAL PLAN AT C.

With regard to the lowness of melting zone claimed by Mr. Higham, this is probably due to the use of blast at a high pressure, and would also account for the high percentage of coke used. The figures given are somewhat misleading, as first it is stated 2 tons were melted with 5 cwt. of coke, or about 12½ per cent., and the figures given in description of test, work out at 11.36 per cent., that is, if 2 tons were melted.

The metal melted during the whole time of the heat was hot, and suitable for running very light work.

I must apologise for the length of this letter, but the possible interest the subject may be to your readers must be my excuse.

Yours faithfully,

W. LITTLETON.

9, Fenchurch Street,
London, E.C.

BRONZE CASTINGS FOR WAR SHIPS.*

The so-called "Diamond" bronze has recently been used in the construction of conning towers for submarines. The alloy is similar to Delta metal and the like, but differs from these in possessing greater tensile strength and ductility and in containing no iron at all. This latter condition is the more valuable in an alloy for ships' castings, since it increases the power of resisting the action of sea-water and prevents disturbance of the compass.

Fig. 1 represents a conning tower in "Diamond" bronze, cast by Ostermann & Flues, of Cologne. The tower is large enough to accommodate all the controlling mechanism of the engines, submerging apparatus, and torpedo tubes, with sufficient room for two or three men.

The moulding (Fig. 2) of this heavy casting is performed in the same manner as with iron castings, but with this difference, that any superfluous metal is more difficult to break up for re-melting, in view of the high breaking strength and ductility, than is the case with iron, mechanical means having to be employed for that purpose.

Very porous sand must be used for the moulds, in order that the gases liberated in casting may have a ready means of escape, and not form cavities in the metal. The core of the mould is stamped at the same time as the outside, and is built up round a large centre of coke to secure porosity. After numerous airways have been made on all sides to enable the steam and gases to escape without hindrance, the boxes are removed in turn, any defects on the surfaces of the mould are made good, and the whole is blacked over with care. The entire mould, core and all, is next placed in the drying oven, and when dry is put together again and made ready for casting.

FIG. 1.—BRONZE CONNING TOWER, CAST BY OSTERMANN & FLUES, OF COLOGNE.

Certain special points require care in casting "Diamond" bronze. The greater the strength of a metal the larger must the casting gates be made, and in this respect "Diamond" bronze is on the same level as steel, so that the mould must be provided with large gates in order that the work may proceed satisfactorily. Hence the gates must be large enough, not only to enable the whole of the mould to be filled with molten metal, but also to themselves contain a sufficiency of metal in the same condition for the clearing process.

Fig. 3 gives a side view of the mould box and an end view of the core. The casting slung from the crane is a bronze cylinder, of 34¼ in. inside diameter, cast

* "Giesserei Zeitung."

by the same firm. This casting is for a hydraulic press, working under a pressure of 7,000 lbs. per sq. in., and weighs about 4 tons. These particulars indicate the progress attained in casting bronze, a metal which should have a wide future before it for various industrial applications.

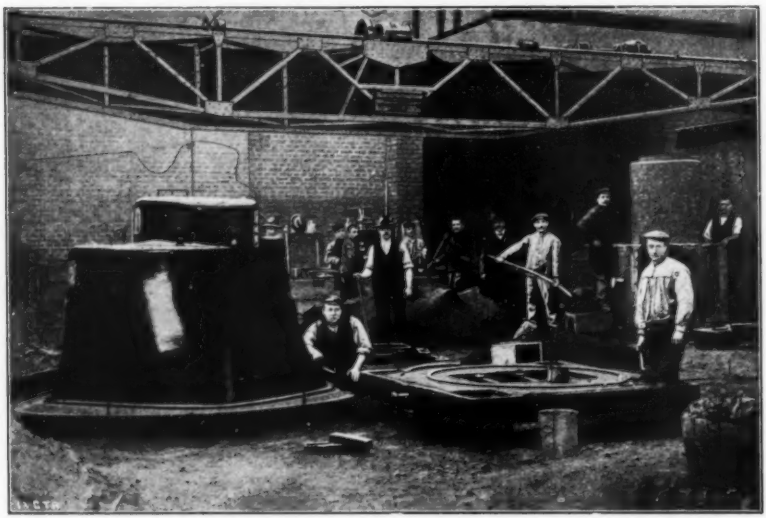

FIG. 2.—MOULDING BRONZE CONNING TOWER.

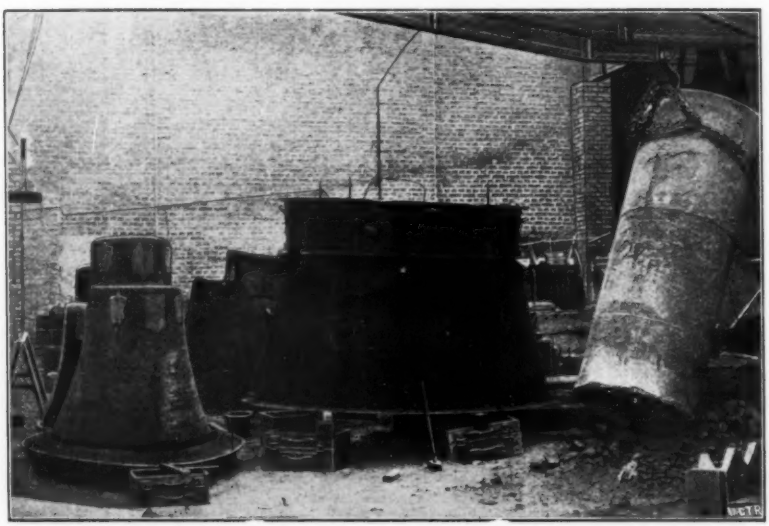

FIG. 3.—SIDE VIEW OF MOULD BOX AND END VIEW OF CORE.

THE HUGHES' ANNEALING FURNACE.

THE apparatus for the annealing of steel castings, etc., illustrated herewith, was invented by Mr. J. Hughes, and designed to accomplish the handling of the material with the greatest possible rapidity.

Figs. 1 and 2 show a furnace applicable to the handling of irregular shapes where cars for the conveying of the material to and from the furnace are employed.

The principal object in the design shown in Figs. 1 and 2 was to provide means for simultaneously handling several lots of material as independent units, so that they might be treated at the same time, but in accordance with the individual requirements of each. It will be seen that there is a longitudinal channel at the bottom of the furnace chamber which communicates with several transverse flues leading to a main flue header. The heating of the chamber is accomplished by burners located in the side walls near the top of the chamber, and the distribution and courses of the flames and hot gases are controlled by the arrangement of the dampers in the flues, which, being counterweighted, may be set at any desired position. The burners or gas inlets are staggered and project the flame against the top and side walls, heating the material which is being treated by radiation and direct impact. The spent gases are drawn down through the lateral flues to the main flue, and are discharged through the stack. The lateral flues can be arranged so that the gases may be drawn out of the furnace above the rollers.

The rollers which carry the cars into and through the furnace chamber are supported, as shown in Fig. 2, on wheels which are journalled on longitudinal beams exterior to the chamber. The rollers are located somewhat below the bottom of the furnace chamber proper, and engage webs or legs on the bottom of the table. At one end of each roller there is a worm wheel, which is engaged by a worm on a short shaft. There are a number of these shafts, usually one to every four rollers; every four rollers forming a single unit. A spur wheel on the short shafts engages a pinion on a long main shaft, which is driven through gears from an electric motor. The main shaft runs continuously, and its pinions are loose, except when engaged by sliding clutches, which put the corresponding set or sets of rollers in motion. The rollers can therefore be operated in sections, any number being run while the others remain stationary, or the whole train may be in action at one time. The subdivided drive makes it possible to introduce or withdraw certain cars while others are kept at the desired point or in a heated zone of the furnace.

The tables are loaded while outside of the furnace chamber, and may be passed into the furnace in succession. The furnace is divided into a number of independent sections, the temperature in each of which is controlled by the dampers of the

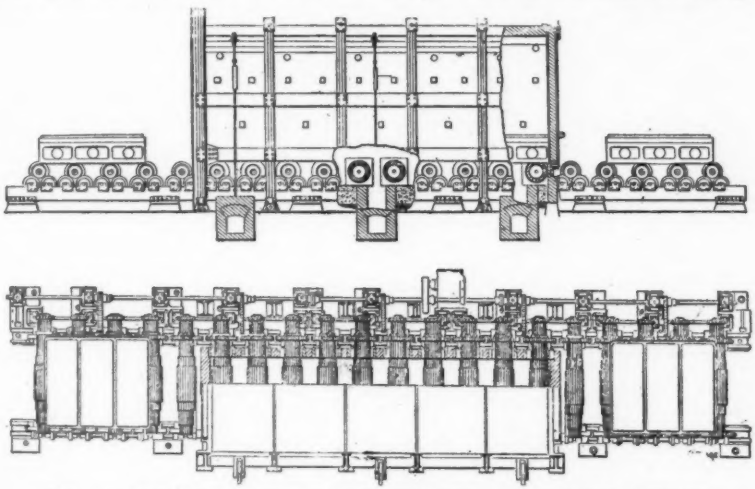

FIG. 1.—SIDE ELEVATION AND PLAN OF HUGHES' ANNEALING FURNACE.

lateral flues, as explained before. The entering table is held for a time in a current of air or modified temperature, which is drawn through the first flue. After the material has received its initial heat it is moved by the rollers into a zone of higher temperature regulated by the second flue. While the first charge is standing in this section of the chamber it may be followed by a second charge of material, which is in a like manner given its initial heat in the section controlled by the first flue. The first charge, after being sufficiently heated, is moved into the third section, where it encounters a modified current of air passing through the third flue, and the temperature is reduced to a proper degree for the charge to be passed out of the furnace. The second and further charges are treated in a similar manner.

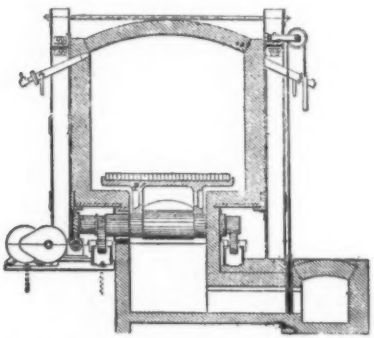

FIG. 2.—TRANSVERSE SECTION, HUGHES' ANNEALING FURNACE.

As the materials carried by different tables are frequently of different sizes and character, it is sometimes desirable to hold particular charges in the furnace at different points for a longer or shorter period than others. This is easily accomplished, since each set of rollers is capable of being operated or thrown out of action to handle any particular charge independent of the others, and the intensity of the heat in any section may be regulated at will.

If the furnace is of sufficient length it may also be used as a muffle. In this furnace there are no journals to become clogged, no water-cooled bearings to be taken care of, and all parts are accessible. Little power is required to drive the rollers, and with the latitude of operation which is possible it seems reasonable to believe that this system of annealing will meet almost any requirement of ordinary practice.

PRACTICAL BRASS-FOUNDING FLASKS.*

By C. VICKERS.

As a proper choice of flasks is a great aid to success in brass founding, a few words on the subject may interest the members of this Association.

An excellent shape for a flask for all kinds of brass work is the one shown in the cut. It will be noticed that the pins are placed on the corners, the flask really being octagonal in shape. This arrangement makes a very neat flask, and one that occupies the minimum of floor space. It is also very light, and the position of the pins greatly facilitate a clean lifting of the cope—a thing so desirable in brass moulding. The sides of the flask are straight, the sand being retained by a narrow ledge on the inside of flask at the joint. My experience has been that a straight side flask with this ledge inside will hold the sand much better than a flask whose sides are bevelled, as the cope of this latter flask has a tendency to sag and cannot be rammed as soft as the straight side flask. The object in placing the pins on the corners is to abolish the projecting lug, as projecting lugs are a bad feature on any brass moulder's flask, because they bind very easily.

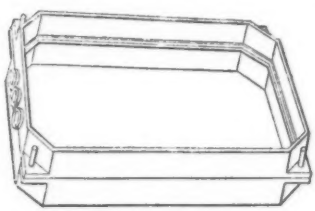

FIG. 1.

In lifting off a cope, the moulder must balance it, and this is made more difficult the farther the pins are extended out from the sides of the flask. The handiest sizes for brass moulders' flasks are 18 by 12 by 6 and 11 by 16 by 5½ inside measurement, that is, 18 in. long, 12 in. wide, and with a 3-in. cope and drag. The 11 by 16 by 5½ size is, I think, to be preferred for general use. Larger flasks than these are heavy and awkward to handle, and unless they are barred are liable to drop out frequently, so it is more economical to have a smaller gate, with fewer patterns,

* Paper read before the American Foundrymen's Association.

and a light and easy working flask, than a larger gate, a few more patterns and a heavy clumsy flask.

Flasks for brass work are much better with four pins than three. The old-fashioned projecting lugged three-pinned flasks, are undesirable for any kind of brass work, not only on account of their liability to shift but because they do not lift with the steadiness of four-pinned flasks. Indeed, a two-pinned flask is to be preferred to a three-pinned one, provided the pins are carried by the handles of the flask as in the snap.

Another point about pins is to make them with a slight taper, as if they are perfectly straight and accurately fit the pin hole, they cause much trouble in securing clean lifts, because the moulder cannot feel the vibration imparted to the cope by rapping on the bench, which is such an important factor in securing perfect work.

Also when the straight pin becomes rusted, as all pins are liable to, it is a difficult job to get the two halves apart and often results in broken flasks.

Pouring Off.

While it is unnecessary to equip the ordinary brass foundry with an electric crane, some sort of a system for lifting and carrying is very desirable. Though comparatively few brass foundries have any such system, they still stick to the old-fashioned man power. Generally the metal is taken from the furnace, by the aid of an iron bar, with a man on either end, another steadying the tongs, and it takes three men to do the pouring, irrespective of the size of the pot or the amount of metal it contains.

When the pot holds 200 lbs. of metal or over it is often a very awkward and dangerous job to take it from the fire in this manner.

All this hand work can be avoided and pouring off become a simple and easy business for one man and a boy by the installation of an overhead track, a trolley and a triplex block. You do not need a shank for pouring off, as a shank needs three and often four men to use it with a tackle.

The overhead track can reach all parts of the foundry with the aid of switches, and pouring can take place in half a dozen places at once if necessary tackle is put in.

The pots are poured with the tongs, using the same tongs as with the bar. The tackle is hooked into the loop on the hinge of tongs, and a hook 18 in. in length is a handy connection between tackle and tongs.

To remove a pot from the furnace the trolley is run over it, a boy having charge of the tackle, the furnaceman or moulder places the tongs on his pot, securing them with the ring as usual, then the hook on the block is lowered into the furnace and catches the loop at hinge of tongs. On the hoisting chain (a triplex block has a single chain), I had a ring large enough to slip over the handle of tongs to hold the pot from overturning. This ring must be slipped off before pouring or the crucible cannot be tipped.

The pot can be skimmed as it hangs, after leaving the furnace, so there is no lowering and hoisting, as with a shank, so the metal leaves the hearth quicker than when carried by hand. When the moulder pours the boy steadies the chain, and the crucible cannot be tipped.

—o—

THE members of the recently-formed North-East Coast Association of Secretaries, at the invitation of the chairman and directors of Head, Wrightson & Company, Limited, of the Teesdale Iron Works, Thornaby, paid a visit to Teesside recently. As little more than half an hour was available, and the works cover an area of 16 acres, the inspection was necessarily a cursory one, but the visitors were enabled to form some idea of the extensive character of the manufactures at Teesdale, and at the subsidiary works of the Company at Eaglescliffe Foundry and Stockton Forge.

CARBORUNDUM FIRE SAND.—Messrs. J. W. Jackman & Company, Limited, write:—This material has been recently largely adopted for a new use in the United States, namely, for making a wash for cupolas. The wash is made of a mixture of 70 per cent. carborundum, 20 per cent. of fire-clay, and 10 per cent. silicate of soda, with sufficient water added so that it can be painted on the surface of the brick. In the past, the melting zone of the cupola was a source of constant trouble and expense to foundrymen. Carborundum cupola wash, applied at regular intervals, will prolong the life of the lining indefinitely, and, at the same time, make a surface that slag will not adhere to and iron will not penetrate. Open joints and holes in brickwork can be closed with carborundum mortar and the lining made as efficient as a new lining. Ladles lined with carborundum mortar will last for several days without attention, the surface remaining free and clean from all slag accumulations.

SPECIAL BRASSES.*

By L. Guillet.

These researches were conducted at the works of the Société Métallurgique de la Bonneville (Eure) and in the laboratories of De Dion-Bouton and Company.

Before taking up the special brasses, it seems necessary to recall in a few words the constitution, the properties and the manufacture of ordinary brass, that is, of alloys of copper and zinc.

The industrial production of brass always includes three steps:—

1. The preparation of the alloy in a molten condition.
2. The casting of the alloy.
3. The working of the alloy in some marketable shape.

To prepare the alloy we may use new copper and zinc, which is expensive, or copper and zinc scrap, at least to a certain extent. The melting is done in crucibles for small quantities, and in reverberatory furnaces for larger amounts. The metal may be cast in castings of any desired shape, or as ingots to be further worked. Rectangular ingots are used for rolling plates, and round ones for the rolling of bars, wire, etc. If the metal is to be cold rolled, long bars of small diameters are cast, while if it is to be hot rolled, ingots of much larger diameter are cast. When the brass contains more than 58 per cent. copper, it must generally be cold worked. The advantage of hot over cold rolling is self evident. In cold working the metal must be annealed and pickled after each reduction.

Special Brasses.

By special brass is meant an alloy of copper and zinc containing one or more other elements purposely introduced to secure some special properties.

The following special brasses have been studied:—(1) Lead brass; (2) tin brass; (3) aluminum brass; (4) manganese brass.

The experiments included micrographic and mechanical tests, and both cast bars and forged and annealed bars were used. Special brasses present much industrial importance because of their mechanical properties and the resistance they offer to certain chemical agents such as sea water and superheated steam. The following figures illustrate the importance of the last consideration. A sample of brass at 15 degrees C. had a tenacity of 38 kilograms per square millimeter, an elastic limit of 15 kilograms and an elongation of 20 per cent., while at 215 degrees C. the tenacity was 29 kilograms, its elastic limit 12 kilograms, and its elongation 21 per cent.

Lead Brass.

Ordinary brass generally contains from 0.5 to 3 per cent. of lead. This small amount of lead is not merely introduced to decrease the cost of the alloy but also to make its working easier. The microscopical examination of brasses containing increasing amounts of lead show that the latter metal failing to alloy with the copper and zinc causes an increasing solidification of the characteristic crystals of the forgeable brasses. The influence of lead is, therefore, to decrease the importance and number of the large, rounded crystals, and this explains why its presence facilitates the turning and even the forging of the metal. When too large a proportion of lead is present, however, it results in a marked liquation and the alloy ceases to be homogeneous. As much as 5 per cent. of lead may be added without liquation, but the fracture assumes then a dull grey colour and shows a very small, close grain. After working, however, the metal has a beautiful yellow tint, even brighter than an alloy containing 60 per cent. of copper and no lead.

With more than 5 per cent. of lead, the alloy is difficult to work. If it be attempted to roll it hot, it frequently happens that the metal "sweats," liquid lead being expelled.

It is, however, possible, with the necessary care, to roll brass containing as much as 7 per cent. of lead. With more lead, that metal collects at the bottom of the moulds when the brass is cast, and during the rolling it is expelled in great abundance.

In brass containing 70 per cent. of copper, and as little as 1.5 per cent. lead, lead globules are formed.

The lead is added when the crucible is still in the furnace, and a short while before casting. The alloy is carefully stirred. Lead, as already stated, facilitates the hot forging of the alloy. The following conclusions may be drawn regarding the influence of lead:—(1) It gradually decreases the tenacity of brasses containing 60 to 70 per cent. copper; (2) it affects similarly the elastic limit; (3) it decreases materially the elongation and reduction of area; (4) it causes brittleness; (5) it does not greatly affect the hardness of the alloy, at least as defined by the Brinell test. To sum up, lead is decidedly detrimental, especially when present in excess of 3 per cent.

* "Revue de Métallurgie."

Tin Brass.

Tin brasses have recently been much used in naval construction. No general study of this group of ternary alloys has yet been conducted, and in the present investigation it has been confined to the influence of tin upon ordinary brass containing 60 per cent. copper and 40 per cent. zinc. Results show that tin plays the same part as zinc, but with a much greater activity, 1 per cent. of tin being as effective as 4 per cent. of zinc.

Photomicrographs of alloys with 54 per cent. copper and 6 per cent. tin and an alloy with 60 per cent. copper and 10 per cent. tin show that the latter alloy has the same structure as the first one, although it contains more copper and more tin. Their structure recalls that of a brass containing 55 per cent. zinc.

The production of these alloys does not call for any special care. Like lead, the tin is added when ready to cast, a short time before removing the crucible from the furnace. Brasses containing more than 4 per cent. of tin can no longer be used, being extremely brittle and having a fracture exhibiting large grains and a silver-grey appearance.

The results show (1) that tin increases a little the tensile strength; (2) that it increases a little the elastic limit; (3) that it rapidly decreases the elongation and reduction as soon as it exceeds 1 per cent.; (4) that it produces a very marked brittleness; and (5) that it increases the hardness. Their deduction agrees with the appearance of the microstructure of these alloys, and it follows that large proportions of tin should not be introduced in brasses. If the brass is to be worked hot, the tin content should not exceed 2.5 per cent. An important property due to the introduction of tin has been shown by numerous experiments, that of greatly increased resistance to corrosion by sea water. The composition generally adopted for naval uses is as follows:—Copper, 60 to 62 per cent.; tin, 1 to 1.5 per cent.; and zinc, 39 to 37 per cent. Tin is also utilised in most brasses of great strength, in which it is present in amounts varying between .3 and 1.5 per cent.

Manganese Brass.

It would seem, therefore, that manganese merely takes the place of zinc, producing a similar effect. To confirm these results an alloy was examined containing 45 per cent. copper, 10 per cent. manganese, and 45 per cent. zinc. It was found to have the same structure as brass containing 45 per cent. copper and 55 per cent. zinc.

The first samples of manganese brass were obtained by Stirling and Parker, who reduced some oxide of manganese by means of carbon in presence of copper and followed by the addition of zinc. In 1876 Parsons, who was the first to study these alloys, added to the copper some ferro-manganese, and utilised the resulting ferro-cupro-manganese for the preparation of manganese brass and manganese bronze. At present cupro-manganese, an alloy of copper and manganese, is universally employed. It is added in suitable proportions a short time before casting. If a large amount of cupro-manganese is to be used, most of it should be melted in the crucible itself, but a little should be kept to be thrown into the crucible when ready to cast. It should be borne in mind that manganese may play in the manufacture of brass (as in that of bronze) a double part: (1) It is a deoxidiser which will reduce the oxides present in the bath; and (2) it confers, when present in excess, special physical properties as shown below.

From numerous tests the following inferences may be drawn regarding the effect of manganese:—(1) It increases decidedly the tensile strength; (2) it increases the elastic limit; (3) at first it increases and then decreases the elongation and reduction. This increase of elongation produced by a small amount of manganese is not evident in the case of rolled bars because a large amount of manganese was at once added; (4) it increases the brittleness, but only when it exceeds 4 per cent.; (5) it increases the hardness very slowly.

Some weldless tubes are manufactured of manganese brass. The following two types of manganese brass are most employed:—

1. Cu, 59 to 60 per cent.; Mn, traces to 1 per cent.; Zn, 41 to 40 per cent.
2. Cu, 58 to 59 per cent.; Mn, 1.8 to 2.2 per cent.; Zn, 40 to 39 per cent.

It should be added that brasses containing manganese only are not those that are most used.

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A SYNDICATE has been formed in this country, consisting of Messrs. Escher, Wyss & Company, Messrs. A. G. Schiff & Company, and Messrs. Mather & Platt, Limited, of Manchester, for the construction and sale of the Zoelly turbine in the United Kingdom and British Colonies, and for granting licences under the Zoelly patents.

METHOD OF MAKING TESTS ON METALS.

In a recent communication to the Société d'Encouragement pour l'Industrie Nationale, M. Guillery describes what may be called a novel method of carrying out mechanical tests on metals. The process in question, which is being brought out by the Société Française de Constructions Mécaniques of Denain, France, is remarkable for its simplicity. The outfit designed by M. Guillery is based on the penetration of balls submitted to a constant pressure on the surface of the metal.

Tests on the penetration of balls are on the contrary truly characteristic of the hardness of a metal, giving as they do a homogeneous result, independently of any factors controlling the behaviour of tensile

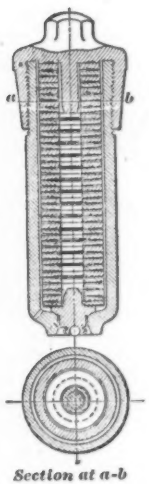

FIG. 1.—PORTABLE APPARATUS; SECTIONAL VIEWS.

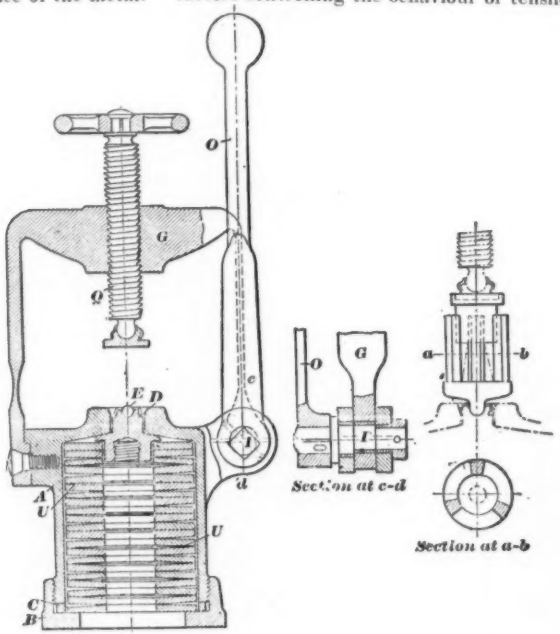

FIG. 2.—PRECISION APPARATUS; SECTIONAL VIEWS.

menter only in some way or other. Hardness, as determined by tensile tests, is a rather imperfect definition of this property, as the effect of contraction which makes itself felt at the moment of breaking is not taken into account. There is further a marked difference in the determination of tensile resistance, according to the dimensions, shape, etc., of the test bars.

This will give the elastic strength, while the elastic limit is determined by means of the indentation of a polished surface of the metal, and for the brittleness the flection of notched bars under impact is relied upon.

According to actual practice, hardness is generally determined by testing the tensile strength, while a number of additional tests relating to the elongation, bending, impact, etc., are frequently required. All of these tests are, however, insufficient by themselves to give any positive indication, and can guide the experistrength. This process, suggested by Mr. Brinell, has a further advantage in that the only necessary preparation is a rough polishing of some square centimetres of the surface of the sample, and a very valuable feature is the fact that tests instead of being limited to separate samples, can be applied immediately to the piece concerned, in as many places as de ired.

The determination of brittleness by the impact of notched bars is no doubt the most perfect process, being based on the determination of the work absorbed by the fracture. As regards the shape of

the notches, nothing definite need be stated, and any desired form can be adopted in connection with the apparatus described by M. Guillery. Square test bars, 10 sq. mm. (.155 sq. in.) in cross section with notches 2 mm. (.0787 in.) deep, are, however, recommended. The metal is indented by a ball pressed against its surface by means of Belleville discs under a given compression. Two types of apparatus have been designed, one of which, being portable, enables any error of magnitude to be detected very rapidly, without, however, affording a sufficient means of checking the investigation of the metal. The other apparatus is an instrument of precision, which, while not being carried about as easily, does not

The precision apparatus seen in Fig. 2 is designed for a statical pressure. It comprises a cylindrical steel box A screwed on a foundation socket B containing the Belleville discs U, and a regulating packing disc C. The pressure of the disc is transmitted to the ball E by means of a support D. On the top there is a lever press serving to compress the sample on the ball until the load being sufficient the discs will collapse and the ball escape. This press consists of a stirrup G, fitted with a regulation screw Q, which serves to transmit the strain; as soon as contact is produced the tightening of the screw has to be discontinued. One of the ends of the stirrup G is connected to an eccentric axle I, worked by the lever O.

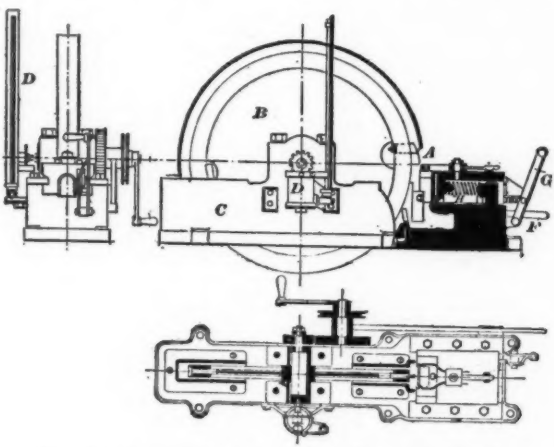

FIG. 3.—APPARATUS FOR TESTING BRITTLENESS; PLAN AND ELEVATIONS.

either require any considerable amount of space. This latter apparatus is a very convenient outfit for tests on delivery and for research work.

The portable apparatus shown in Fig. 1 is designed for balls 5 mm. (.197 in.) in diameter. It is fitted with a head, to which a blow is applied, so as to give the pressure required (750 kgs. or 1,650 lbs.) without requiring any resting point. The excess of live force is absorbed by a circular stop striking the test piece as soon as the load required has been obtained. A similar apparatus has been constructed for balls 10 mm. (.394 in.) in diameter, with loads of about 3,000 kgs. (6,600 lbs.). This apparatus seems to be especially adapted for measuring the hardness of metal raised to fairly high temperatures.

The eccentricity is 1.5 mm. (.059 in.), so that by moving the lever through 180 degrees the sample is indented by that amount. Calibration is carried out, as in the case of a tensile testing machine, by means of a metal of known hardness. The apparatus using 10 mm. (.394 in.) balls is adjusted so as to make an impression of 7 mm. (.276 in.) in the rings. The bronze used at the mint for medals seems to give the most reliable results for calibration purposes. Comparative tests have been made on the figures given by tensile testing machines on the one hand and by the present apparatus on the other. Up to 64 kgs. the test pieces were made of annealed steel of increasing hardness, while the last two were of tempered spring steel. The diameters of the im-

prints were measured by means of the Le Chatelier glass gauge, allowing of 1-10 millimetre (4-1000 in.) being safely estimated with the naked eye. The gauge here mentioned is probably a strip of glass ruled with two slightly converging lines. These are graduated to correspond with the distance the two lines are separated at any point. The strip being placed over any indentation or whatever is to be measured and the position of the glass adjusted until the object just bridges the interval spaced by the graduated lines, the diameter may be read off from the scale.

The apparatus just described is without any previous alteration immediately suitable for ascertaining the elastic limit, it being sufficient to insert in a threaded link, located under the screw of the apparatus, frustums of polished cones, subjecting them to a maximum constant load, when the elastic limit is inferred from the ratio of the deformed cross section with the load.

The apparatus for determining brittleness (Fig. 3) utilises a flywheel, which on being started at a convenient speed produces the fracture of the test bar. The resulting variation of live force is shown by the diminution in speed through a direct reading. A steel flywheel B, being perfectly balanced, carries on its rim the knife edge that breaks the sample. The axle of the flywheel rests in two ball bearings, and at the instant of impact it is borne on surfaces of ample area. The flywheel is regulated either mechanically or by hand to a speed such that the energy stored in the mass will be greater than that which in all cases is required to break the bar, and the speed of impact equal to that adopted in the brittleness test, that is corresponding to a free fall through 4 mm. (.157 in.). A cylindrical clutch the movable element of which is mounted on the lever serves to regulate the drive. This lever, being generally hooked to the frame, is made to engage the clutch on being released, when the flywheel begins gradually turning round up to the normal speed either under the action of the hand on a crank or in virtue of a rope transmission acting on the grooved pulley. The notched bar is placed between bearings on a sliding anvil. This anvil, which is of cast steel, carries a plate of hardened steel turned towards the blow; a spring of sufficient strength always tends to move the anvil towards the wheel, that is into the position where it will receive a blow. The mechanism locating the test piece under the knife edge in due season is a cam fixed on a rod, controlling it with a rotary movement, but traversing it freely in the direction of the axis. This rod terminates in a latch worked by a spring, which tends to keep the cam in gear and places the lever in front of the operator. When, by the aid of the lever, placed in front of the apparatus, the anvil is pulled towards the operator, the spring throws the cam into gear, and the latch becomes horizontal. When the lever is pushed the rod is displaced and the latch receives a blow from the knife edge, which throws the cam out of gear and leaves the anvil to the influence of the spring, this action being instantaneous. After the knife edge has made one complete revolution it strikes the test bar.

The speed and the work absorbed are given at any moment by a tachometer, consisting of a small centrifugal pump on a vertical axis. This is fitted with a graduated water level gauge. A safety mechanism renders it impossible to insert the test bar when the anvil is out of gear. The flywheel is covered by an iron case, protecting it against the risk of striking any projection.

PERSONAL

Sir Joseph Lawrence, M.P., is absent in America.

The late Sir Benjamin Hingley left estate of the gross value of £130,000.

Mr. W. T. Bell has been elected a director of Robey & Company, Limited, of Lincoln.

The late Mr. P. F. Ibbotson, edge tool manufacturer, of Sheffield, left estate of the net value of £6,000.

Mr. J. Sampson, of T. Firth & Sons, Limited, has been elected a director of John Brown & Company, Limited.

Mr. David Colville and Mr. Andrew Lamberton have been elected members of the Council of the Iron and Steel Institute.

Sir Charles Mark Palmer, M.P., has resumed his Parliamentary duties after several months' absence, owing to serious illness.

The gross value of the estate of the late Mr. J. Spencer, of John Spencer & Sons, Limited, Newburn Steel Works, is £370,074.

The gross value of the estate of the late Mr. C. G. Jackson, head of the Ince Coal and Iron Company, Limited, amounts to £127,573.

The King has knighted Alderman Jonas, of Messrs. Jonas & Colver, and Lord Mayor of Sheffield.

The late Mr. C. D. W. Cammell, at one time a director of Cammell, Laird & Company, Limited, left estate valued at £1,027 gross.

Mr. G. Fisher recently retired from the position of blast furnace manager to the Shelton Iron, Steel, and Coal Company, Limited.

Mr. P. Hill, manager of the Coatbridge Iron Works, was recently knocked down by a motor car, and now lies in a critical condition.

The value of the estate left by the late Mr. James Napier, of the firm of Messrs. Napier & McIntyre, iron merchants, Glasgow, is £80,316 gross.

Mr. F. J. Perrott, who has just resigned his position with the Northam Iron Works, has been the recipient of a presentation from the staff and friends.

Mr. A. Allen has been taken into partnership in the firm of W. & S. S. Allen, bolt and nut manufacturers, etc., of the Sodom Works, Coseley, near Bilston.

Mr. J. Dodgson, cashier to the Parkgate Iron and Steel Company, Limited, who has just completed sixty years of continuous service, has been the recipient of a presentation from the officials and men.

Mr. E. Windsor Richards was rather seriously hurt in a motoring accident while touring in France recently. Mr. E. P. Martin and Mr. Coppée, who were with him, however, escaped practically uninjured.

The late Mr. Enoch Horton, of the Alma Works, Darlaston, vice-chairman of John Brotherton, Limited, and a director of the Staffordshire Bolt, Nut, and Fencing Company, Limited, left property of the gross value of £160,808.

Mr. W. Bushell Parke, for 35 years secretary to Messrs. Thomas Butlin & Company, iron makers, Wellingborough, was recently the recipient of a presentation on the occasion of his retirement. Mr. A. J. Parmee has been appointed secretary to the company, and also to the Northamptonshire Direct-Castings Company, Limited, in the place of Mr. Parke.

In connection with the appointments made on the occasion of the King's birthday, we find that baronetcies have been conferred upon Mr. Charles Holcroft and Mr. J. C. Wernher. Mr. Holcroft is on the directorate of the Horseley Company, Limited, while Mr. Wernher is chairman of Fraser & Chalmers, Limited. The honour of knighthood has been received, among other gentlemen, by Mr. A. Helder, M.P., and Colonel S. A. Sadler, M.P. Mr. Helder is a director of H. R. Baines & Company, Limited, J. Robinson & Company, Limited, the Wyndham Mining Company, Limited, and other concerns. Colonel Sadler is chairman of the well-known firm of Sadler & Company, Limited.

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OBITUARY.

Mr. W. Bartle, of F. Bartle & Sons, Basset Foundry, Carn Brea, Cornwall.

Mr. T. Birchall, manager of the Whitecross Iron Company, Warrington.

Mr. C. A. Otis, of Cleveland, U.S.A., the original owner of the Otis Steel Company.

Mr. Alfred Steel, connected with William Jessop & Sons, Limited, for nearly 50 years.

Mr. G. S. Newsum, who has been connected with Harrison & Camm, Limited, for over 40 years.

Mr. W. B. Dick, founder and head of the firm of Dick, Kerr & Company, Limited, electrical engineers.

Sir Peter Nicol Russell, the well-known Australian engineer, who founded the P. N. Russell School of Engineering.

Mr. E. S. Brett, who introduced drop forgings into Coventry about fourteen years ago, establishing the firm of Bretts, Limited.

Mr. Archibald P. Head, senior partner in the firm of Jeremiah Head & Sons, of 47, Victoria Street, Westminster, S.W., the British representatives of the Wellman-Seaver-Morgan Company, and the Otis Steel Company.

Mr. William Jessop, of Thornsett Lodge, Bradfield, after a very long illness. The deceased gentleman was well-known as the chairman of William Jessop & Sons, Limited, steel manufacturers, of Brightside, Sheffield, and was also a director of the Yorkshire Engine Company.

Mr. W. Black, of the firm of Messrs. Black, Hawthorn & Company, Gateshead, in his 83rd year. Early in life Mr. Black

turned his attention to the iron trade, and commenced a foundry at Fatfield, near Washington, and eventually he extended his business operations by taking over the North-Eastern Foundry at South Shields from Messrs. Stainton. Later, in conjunction with other gentlemen, he founded the well-known firm of Messrs. Black, Hawthorn & Company. Mr. Black was also one of the promoters of the North - Eastern Marine Engineering Works at Sunderland and Wallsend.

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COMPANY NEWS.

ROYCE, LIMITED.—Dividend on the cumulative preference shares, passed.

BROWN BAYLEY'S STEEL WORKS, LIMITED.—Interim dividend of 5 per cent.

RHYMNEY IRON COMPANY, LIMITED.—Ordinary dividend, 2 per cent.; carry forward, £1,259.

GREENWOOD & BATLEY, LIMITED.—Ordinary dividend, 6 per cent.; carry forward, £6,026.

GENERAL ELECTRIC COMPANY, LIMITED.—Net trading profits, £73,822; ordinary dividend, 5 per cent.; reserve, £15,987.

COGHLAN STEEL AND IRON COMPANY, LIMITED.—Ordinary dividend, 6 per cent.; reserve, £2,000; carried to next account, £2,340.

JOHN BROWN & COMPANY, LIMITED.—Annual profits, £218,556; dividends, 1s. 2d. each on the fully-paid ordinary shares and 10½d. each on the part-paid shares.

ELLIOTT'S METAL COMPANY, LIMITED.—Preference dividend, 5 per cent.; ordinary dividend, 5 per cent.; reserve fund, £8,000; depreciation, £5,000; carry forward, £2,035.

THOMAS PARKER, LIMITED.—Adverse balance for year, which it is proposed to meet by transferring £6,000 from the reserve fund, and carrying forward £153 19s. 1d.

DAVY BROTHERS, LIMITED.—Gross profit for year, £8,946 4s. 8d.; preference dividend, 5 per cent. per annum; ordinary, 4 per cent. per annum; reserve, £1,000; carried forward, £490 7s. 11d.

SAMUEL HEATH & SONS, LIMITED.—Profit for year, £6,220 5s. 9d.; dividend, 6 per cent. per annum for the half-year on the preference shares; depreciation, £750; carry forward, £133 14s. 8d.

FURNESS, WITHY, & COMPANY, LIMITED. — Annual profit, £271,087; ordinary dividend, 5 per cent. per annum (making 10 per cent. for the year, free of income-tax); £36,382 carried forward.

SOUTH DURHAM IRON AND STEEL COMPANY, LIMITED.—The directors recommend paying arrears of dividends on the 6 per cent. cumulative preference shares and an interim dividend of 5 per cent. on the ordinary shares.

VICKERS, SONS & MAXIM, LIMITED.—Interim dividends for the half-year ended June 30 last:—2½ per cent. on the preference, 5 per cent. stock and 5 per cent. preference shares; 1s. per share on the ordinary shares.

DAVID & WILLIAM HENDERSON & COMPANY, LIMITED.—Annual profit, £31,077 14s. 5d.; brought forward, £13,441 9s. 9d.; preference dividend absorbs £7,500; ordinary dividend, 5 per cent. per annum; carried forward, £12,299.

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TRADE TALK.

MR. T. W. BROADHURST, malleable-ironfounder, of Wallsall, Staffs., has been adjudged bankrupt.

H. COOPER & COMPANY have just taken possession of their new Vulcan Rivet and Brass Works, Sheffield.

AN invention of Mr. R. A. Hadfield, to increase the toughness of steel has been accepted by the Patent Office.

THE DELTA METAL COMPANY, LIMITED, have erected new works and offices at East Greenwich, London, S.E.

JAMES HODGKINSON, LIMITED, have moved from Cross Lane, Salford, to Ford Lane Works, Broad Street, Pendleton.

MESSRS. HARDIE & MUNROE have acquired the Loanhead Foundry, Loanhead, from Messrs. Aitchison & Company.

MESSRS. FAIRBANKS & COMPANY, of City Road, London, E.C., have opened branch offices in Bothwell Street, Glasgow.

MOSER, WEST & BATEMAN, LIMITED, of Westcombe Hill, Charlton, have acquired the business of Rooper & Harris, of Stafford.

CONSIDERABLE developments are shortly to be carried on at the Dowlais Steel Works, involving an expenditure of £250,000.

MR. G. DUPONT has been appointed representative to J. Crowley & Company, Limited, Meadow Hall Iron Works, Sheffield.

THE SAXON ENGINEERING COMPANY, LIMITED, has been registered with a

capital of £5,000, in £1 shares (4,000 preference).

MILLER & COMPANY, LIMITED, London Road Foundry, Edinburgh, are supplying chilled iron wagon wheels and axles to the Bengal-Nagpur Railway.

THE CONSOLIDATED ENGINEERING COMPANY, LIMITED, of Slough, are erecting at their works a plant for making steel castings under a new process.

THE WEST HARTLEPOOL TOWN COUNCIL have arranged terms for the supply of electrical current to the Seaton Carew Iron Works for power purposes.

HENRY POOLEY & SON, LIMITED, of Temple Street, Birmingham, have now completed the equipment of their Falcon Works, Brook Street, Smethwick.

MESSRS. J. SIDAWAY & COMPANY, chain and anchor manufacturers, of Saxon Works, Cradley Heath, are disposing of their business by private treaty.

THE business of Erith's Engineering Company has been turned into a limited liability concern, with a capital of £30,000 in £1 shares (20,000 preference).

THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED, have removed their Glasgow office from 141, West George Street, to 91, Wellington Street.

MESSRS. E. A. HIPKINS, C. A. JUKES, A. E. TORRANCE, and E. L. WHITEHOUSE, have retired from Messrs. J. & J. Whitehouse, ironfounders, Tipton, Staffs.

MESSRS. F. E. WILSON, W. H. WILSON, C. A. WILSON, E. BARBER, and W. T. WILSON, engineers, etc., Lordship Lane, Wood Green, have dissolved partnership.

THE directors of Fawcett, Preston & Company, Limited, Phœnix Foundry, Liverpool, announce that the reconstruction of the company has been completed.

MESSRS. WOOD & CRAWFORD, who recently obtained the sole right of manufacture of Ford's patent heating furnace, have removed to 86, Queen Street, Sheffield.

THE BRADLEY HALL IRON WORKS, Bilston, were offered for sale by public auction recently. No bids were made, and the property was, accordingly, withdrawn.

THE average net selling price of No. 3 G.M.B. Cleveland pig-iron for the second quarter of the year, was 47s. 0.86d., as against 45s. 6.89d. for the previous three months.

MESSRS. J. W. CLARIDGE and C. E. GRINDON, general engineers, Gracechurch Street, E.C., who traded under the style of Claridge & Company, have dissolved partnership.

A DISSOLUTION of partnership is notified in connection with Messrs. E. H. Green, J. E. Green, and J. W. T. Brain (T. Green & Company), ironfounders, of Coseley, Staffs.

A COMPANY has been formed to take over the business of Manning, Wardle & Company, locomotive engineers, of Jack Lane, Hunslet, which was started nearly half a century ago.

CONSIDERABLE developments are being carried out in the steel department at the works of Kynoch, Limited, at Witton, where heavy anchors for the Admiralty are now being produced.

JARVIS BROTHERS, LIMITED, is the style of a company formed to acquire the business of E. F. Jarvis, Middlesbrough, and to carry on the business of manufacturers of water-cooling plant.

WITH reference to the death of Mr. W. Black, the principal of the North-Eastern Foundry, South Shields, the executors intimate that the foundry will be continued as heretofore.

MESSRS. M. COCKBURN & COMPANY, ironfounders, of Falkirk, have removed their London offices from Westminster Bridge Wharf to 115, Hamilton House, Bishopsgate Street Without.

ANDREW BARCLAY, SONS & COMPANY, LIMITED, of the Caledonia Works, Kilmarnock, N.B., have appointed Mr. J. Cawley, 13, Victoria Street, Westminster, as their London representative.

THE METROPOLITAN AMALGAMATED RAILWAY CARRIAGE AND WAGON COMPANY have acquired the works at Hadley, near Wellington, Salop, until recently carried on by the Milne Tramcar Company.

THE engine and boiler shops in the Clydebank shipyard of John Brown & Company, Limited, are now supplied with a complete installation of electric power generated by gas engines.

AN amalgamation has taken place between the Ingersoll-Sergeant Drill Company, Limited, and the Rand Drill Company, and in future the combine will be known as the Ingersoll-Rand Company.

THE RHODES ELECTRICAL MANUFACTURING COMPANY, LIMITED, announce that their Newcastle-on-Tyne representatives —Messrs. Sleigh & Wood—are removing to Milburn House, Newcastle-on-Tyne.

MR. B. ELTON, ironfounder, of Edgbaston and Tipton, has been adjudged bankrupt. The gross liabilities are £464 odd, and the assets are estimated at £93 16s. 6d., leaving a deficiency of £329 odd.

DAVY BROTHERS, LIMITED, Sheffield, are supplying two sets of engines for driv

ing plate-rolling mills, and a large metal-mixer of 150 tons capacity, for the works of the Hang Yang Steel Company, of China.

Messrs. T. S. Bond, T. Parkinson, and A. C. Davey, iron and brass founders, Longridge, Lancashire, who traded under the style of Bond & Company, have dissolved partnership, so far as regards Mr. T. S. Bond.

A receiving order has been made against Mr. H. Munrow, ironfounder, Walsall. The gross liabilities are estimated at £1,470 16s. 3d., and the assets at £305 14s. 2d., leaving a deficiency of £118 0s. 7d.

Messrs. Johnson & Phillips have appointed Messrs. Guthrie Brothers & Ogilvy, Newcastle-on-Tyne, their sole representatives for the counties of Northumberland, Durham, Cumberland, and Westmorland.

Head, Wrightson & Company, Limited, have acquired land adjoining their Teesdale Iron Works, Thornaby-on-Tees, which will enable them to make a much-needed extension of their bridge-yard department.

The Government have decided, according to Dr. Ludwig Mond at a meeting of the Mond Nickel Company in London, to use nickel steel for heavy guns, and the Admiralty have, after a series of successful tests, adopted nickel steel for battleship armour-plates.

Newton & Company, Limited, has been formed to acquire the brass and iron foundry business carried on at Bute Works, Beale Street, Aston, Birmingham, by Newton & Company. The capital is £1,000 in £1 shares.

To meet the requirements of the increased number of chain manufacturers in the Cradley Heath district, Lloyds' Proving House Company have established a proving and testing house at Corngreaves, Cradley Heath.

The Widnes Foundry Company, Limited, is the style of a new concern formed with a capital of £100,000 in £10 shares (5,000 preference), to acquire the business carried on at Widnes as the Widnes Foundry Company.

Peter Pilkington, Limited, has been registered with a capital of £30,000 in £1 shares (10,000 preference), to acquire the business formerly carried on by Peter Pilkington, Limited, at the Dowry Iron Works, Bamber Bridge, Lancs.

The Steel Castings Company, Limited, Alliance Steel Foundry, South Bank, near Middlesbrough, have appointed Mr. T. H. Starkey, of Rosebery Buildings, John Bright Street, Birmingham, as their representative in the Midlands.

The business recently carried on at Lionel Street, Birmingham, by W. & J. Player, Limited, power-hammer makers and engineers, has been purchased by Messrs. Ewen & Mitton, of Smithfield Works, Sherlock Street, Birmingham.

A dissolution of partnership is notified in connection with Messrs. T. Morris, H. Millington, and W. H. Green, ironfounders, Walkden, who traded under the style of Morris, Millington & Company, so far as regards Mr. H. Millington.

The General Electric Company, Limited, of Salford, Manchester, are carrying out extensive improvements at their works, a new building having been erected close to the main works for the accommodation of the instrument-making department.

The Sheepbridge Coal and Iron Company, Limited, of Chesterfield, recently secured an order for 24-in. pipes for the Manchester Corporation. They have also just commenced upon an extensive order for 20-in. to 30-in. pipes for the Derwent Valley Water Board.

Messrs. Stedman, Crowther & Company, 4, Lime Street, and Messrs. Geo. Warren & Company, 98, Great Tower Street, have been appointed joint export agents in London for the sale of galvanised black sheets manufactured by J. Summers & Sons, Limited, Globe Iron Works, Stalybridge.

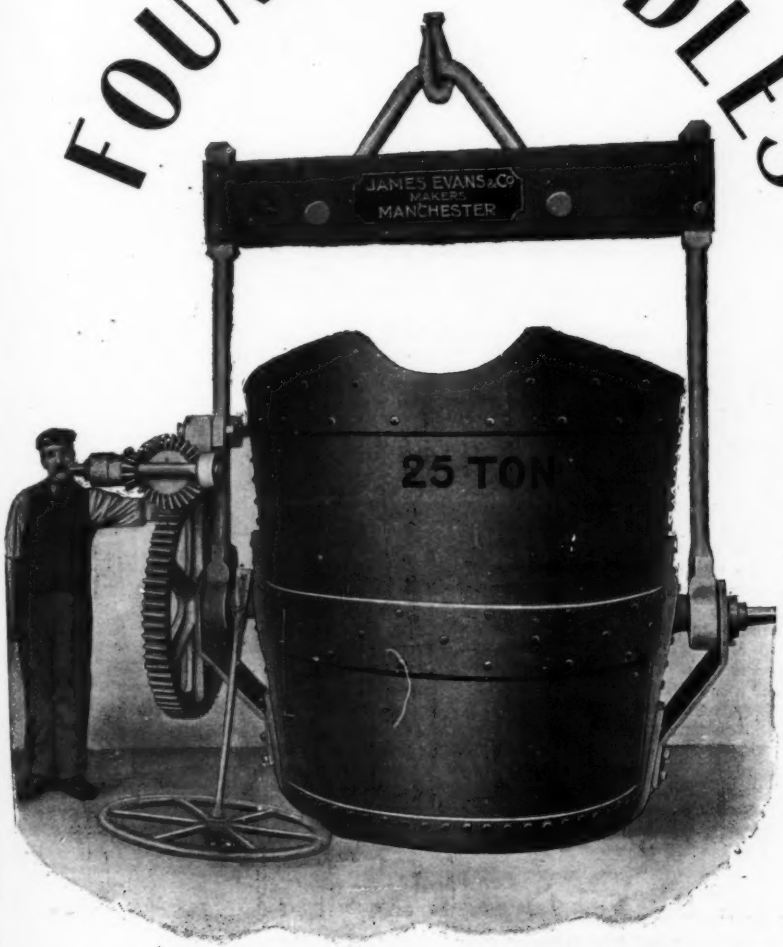
The Electric Railway and Tramway Carriage Works, Limited, of Preston, have taken over the Castle Car Works (late G. F. Milnes & Company, Limited), of Hadley, Salop, and the British Electric Car Works, of Trafford Park, Manchester, and in future the combination will be known as the United Electric Car Company.

The Landore Works of the British Mannesman Tube Company are at present working at their full capacity. The orders in hand include special work for the Chilian Navy, water main weldless piping for the Swansea, Bournemouth, Christchurch, and other Corporations, and tramway standards for Leith and other places.

A fire broke out at the East Bute Dock, Cardiff, recently, by which the Ninian Foundry, owned by Mr. Charles Jones, and the Equilibrium Patent Piston Works, belonging to Messrs. P. Baker & Company, adjoining—two large buildings constructed of galvanised iron—were gutted, the damage amounting to practically £8,000.

Contractors to H.M. Government.

FOUNDRY LADLES



JAMES EVANS & Co., FOUNDRY ENGINEERS,

Telegrams:
"LADLES, MANCHESTER."

BRITANNIA WORKS, MANCHESTER.

MOULDS FOR STEEL CASTINGS.

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—I cannot let the remarks made in your last issue by Mr. Chipchase pass without an explanation.

In the first place, he points out my error in saying that a plate was used for the inside of the core. This, I admit, was a mistake on my part in calling it a plate in place of a grid. I certainly ought to have known better, especially so because of a lesson I once had through a similar misapplication of the names —plate and grid. It was a case which occurred a good number of years ago. I was then working for a small jobbing master, who was a good theoretical man but had not much practical knowledge. He one day asked me to hunt round some of the foundries in Glasgow to see if I could find one which had a ready-made pattern of a diamond *plate*. I found one, and, according to instructions, got four cast the required size, quite pleased with myself at being able to get the job done so quickly. Imagine my dismay when, on the castings being delivered, and seen by the "Boss," I was asked what I meant by getting solid diamond plates when he wanted them with holes in? Now, if he had said diamond grids, or told me what he wanted them for, I should have got the right ones. This is my point, that though the word plate was used, I explained what it was for, and I credited the moulder who would tackle that job with sufficient "gumption" to know what was required.

As regard the second correction, I am very much obliged to Mr. Chipchase for giving the explanation, and, what is still better, the reason for the same. I would like to throw up my hands and cry done ; but in justice to myself I must explain how it came about. When the question of making the pulley was first discussed, the method of casting which I described was certainly considered, and if Mr. Chipchase finally decided to cast it as he states, I knew nothing about it. Probably I was away at the time he finished it.

I certainly take the explanation in the spirit in which it was given; in fact, I am very pleased that he has given it, for it has added a little more to my store of knowledge.

Yours, etc.,
W. PETERS.

—o—

QUERIES.

This department of the JOURNAL *undertakes the answering of queries in foundry practice and pattern-making. We trust our readers will afford us assistance in answering these queries so far as possible.*

BLOWHOLES IN CASTINGS.—Can any of your readers give me a mixture for stopping-up small blowholes in motor-car cylinder castings? It must stand the constant vibration and contraction and expansion, which a screwed plug won't stand without becoming loose. Very often an otherwise perfect cylinder is scrapped through a hole ⅛ in. diameter.—TROUBLED.

—o—

MASON'S GAS POWER COMPANY, LIMITED, have taken over the Alma Works, Levenshulme, Manchester, and the business in gas producers and furnaces carried on by W. F. Mason, Limited. The transfer includes the plant, patents, drawings, designs, and trading rights in gas producers and manufacturers of the Duu and Whitfield patent gas producers, and sole licensees for the Weardale patent furnace.

Ganister, Cupola Blocks, Fire Bricks,
Fire Clay.
Silica Bricks, Tuyeres, Stoppers, Nozzles, &c.
Steel Moulders' Composition, Silica Cement.
J. GRAYSON LOWOOD & Co., Ltd.,
DEEPCAR, nr. SHEFFIELD.
Telegrams: "LOWOOD, DEEPCAR."

ELDERS FOUNDRY COKE

As supplied to the
British . .
Admiralty Dockyards.

The following, selected from numerous letters, are eminent testimony as to the quality of our celebrated "A.A.A." Coppee Foundry Coke, carefully selected, and despatched in sheeted wagons.

From PECKETT & SONS, Bristol.

Bristol, October 25th, 1904.

We have been using your Selected Foundry Coke for some considerable time.
We have pleasure in stating that we are very pleased with it, as we find we get sounder and cleaner castings, more free from blow-holes and other defects, than we formerly did.

From MOUNTFORT PHILLIPS & Co., Llantrissant.

Llantrissant, October 25th, 1904.

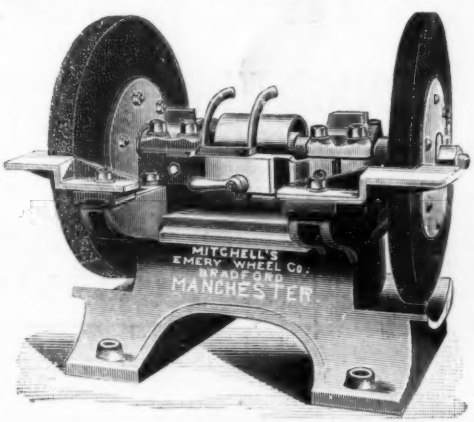
In reference to the Foundry Coke you have been supplying us with for the last six months, we have very great pleasure in letting you know that it has given every satisfaction, and that our Works Manager and Workmen give it the highest praise.

Elders Navigation Collieries, LTD. Cardiff.

MACHINES. For all Purposes. **WHEELS.**

Complete with Emery or Corundum Wheels from **£2** upwards.

Special Machines Designed.



Emery or Corundum from 1 in. x $\frac{1}{8}$ in. to 50 in. x 12 in.

Enquiries solicited.

MITCHELL'S EMERY WHEEL Co.,

Mill Street, Bradford, MANCHESTER.

Also at LONDON, GLASGOW, and BELFAST. LISTS FREE.

PRICES OF METALS.

The following table shows the approximate latest prices and position of stocks of metals during the past two years :—

Metals.	1904-5.	1903-4.
Iron—Scotch pig warrant ... ton	—	—
—Middlesbro' warrants ... ... ton	45/4	42,9½
—W.C. M/nos Bessemer ... ... ton	57,0	54,0
—Stock. Scotch, July 20 ...tons	17,730	9,650
Copper—Chili bars, GMB ... ... ton	£67 6 3	£56 12 6
—Stock, Europe & afloat... ... tons	17,735	11,137
Tin—English ingots ton	£146 5/0	—
—Straits ... ton	£145 10,0	£123
—Stock, Ldn. Hind and afit ... tons	12,824	14,789
Lead—English pig ton	£14 2,6	£11 17,6
Spelter—Ord. Silesian ... ... ton	£24	£22 10,0
Quicksilver-(75lb.) bottle	£7 7,6	£7 17,6
Antimony—Regulus ... ... ton	£37 10,0	£26 10,0

Castings.

In the Cleveland district the following are the nominal rates current for castings :—

	£ s. d.		£ s. d.
Columns (plain)	6 10 0	to	7 0 0
Pipes, 1½ to 2½ in.	4 17 6	to	5 2 6
,, 3 to 4 in....	4 7 6	to	4 10 0
,, 5 to 8 in.	4 7 6	to	4 10 0
,, 10 to 16 in....	4 7 6	to	4 10 0
,, 18 to 24 in....	4 7 6	to	4 10 0
Chairs	3 10 0	to	3 12 6
Floor plates (open sand)	2 15 0	to	2 17 6

Scrap.

The quotation for scrap subject to market fluctuations is as follows:—Engineers' heavy scrap, 50s. to 52s. 6d.; ditto light scrap, 20s. to 22s. 6d.; clean scrap brass, 39s. 6d.; clean scrap copper, 60s.; lead (usual draft), 12s. 0d.; tea lead, 10s. 9d.; zinc, 17s. 3d.; hollow pewter, 100s.; black pewter, 65s. per cwt.

—o—

The Societe Electro-Metallurgique Francaise, of Froges, have granted an exclusive licence to work the Héroult electric steel-smelting process for the United Kingdom to the Sheffield Steelmakers, Limited, who are stated to be making arrangements for erecting special works for the manufacture of steel under the Héroult patents.

SILICA FIRE BRICK Co.,

OUGHTIBRIDGE.

GROUND GANISTER,

Wet or Dry.

Silco Cupola Bricks, 90 % Silica.

Established 1863.

Jas. Durrans & Sons,

PHŒNIX WORKS, PENISTONE,

Nr. Sheffield.

Manufacturers of all

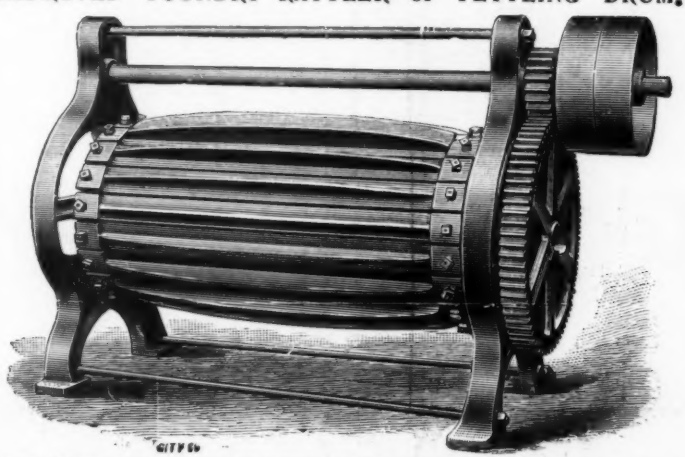
FOUNDRY EQUIPMENTS

Composition Black Lead,

Plumbago, Core Gum, White Dust, and Coal Dust.

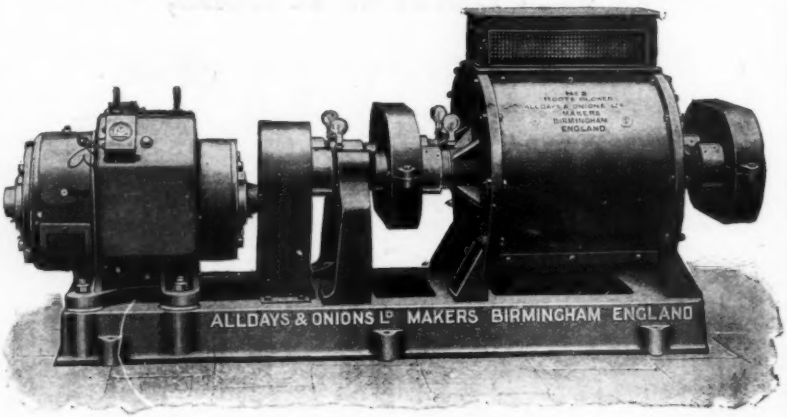
Ladles, Cupolas, Fire Bricks, Gannister, Stone Flux, Loam and Sand Mills, Casting Cleaners, Studs, Chaplets, Pipe Nails, Sprigs, Brushes, Wire Brushes, Core Ropes, Bellows, Buckets, Spades, Forks, Riddles, Sieves, Barrows, &c.

IMPROVED FOUNDRY RATTLER or FETTLING DRUM.



These Machines are invaluable for a Foundry, doing a larger amount of work of a superior quality, in a much shorter time than can be done by hand, without skilled labour.

ROOTS BLOWERS.



ALLDAYS & ONIONS PNEUMATIC ENGINEERING CO., LTD., BIRMINGHAM.

AND AT 20 BUCKLERSBURY, LONDON, E.C. Telegrams: "ALLDAYS, BIRMINGHAM."

38½"

McNEIL'S PATENT UNBREAKABLE STEEL LADLES

36"

These Ladles are manufactured by a patented process, each from a single steel plate without weld or rivet. They are extremely light, being at the same time the strongest and most durable in the market. Ladles to contain 56 lb. of metal only weigh about 7 lb. each. They are made of all capacities from 30 lb. to 60 cwt., with or without lips; also mounted or unmounted. They are also suitable for chemical and metallurgical processes. List of sections and prices on application to

CHAS. McNEIL.

KINNING PARK IRONWORKS, GLASGOW.

32½"

Can also be made in Aluminium.

CHARLES D. PHILLIPS'
Registered and Improved
Foundry Core Oven,
Indispensable in any Foundry using small Cores.

Registered No. 356,812.

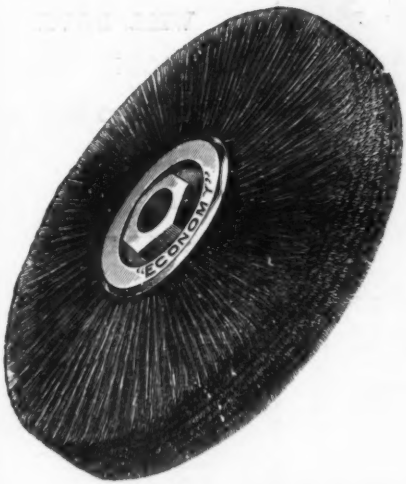
OVEN BUILT IN WALL

4 Shelves, each 10 inches deep. Sizes: Front width, 3 ft. 6 in.; height, 4 ft. 8 in. Inside, width, 3 ft.; depth, 2 ft. 7 in.; height, 4 ft. 3 in.

Price. £12 10 0

CHARLES D. PHILLIPS,
Emlyn Iron Works. NEWPORT (Mon.).

HUB IS NOT THROWN AWAY



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is worn out, because you can place fresh layers of Steel Wire on it yourself.

Used on Emery Grinders, they are found invaluable for

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Many other uses are always being found for them.

THE SPECIAL WIRE DOES NOT LAY DOWN OR BREAK OFF.

SIZES, 15 INCHES DIAMETER DOWN TO 8 INCHES.

J.W.&C.J.PHILLIPS,

College Hill, London, Eng.

The McClelland Patent

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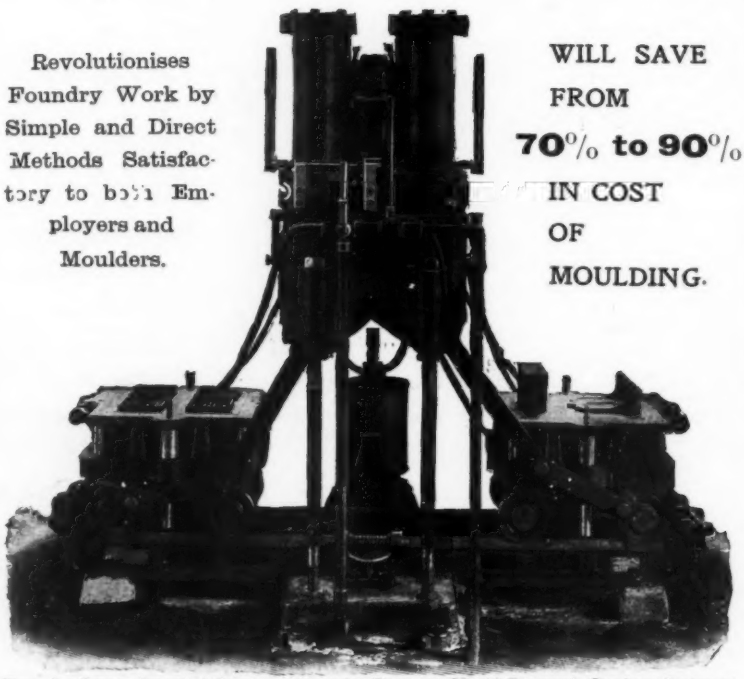
Revolutionises Foundry Work by Simple and Direct Methods Satisfactory to both Employers and Moulders.



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Type A.—Power Operated Carriage run under Rammer, Mould Rammed, Carriage Returned and Box Lifted, all Automatically. Arranged or one or two men to work continuously.

NO OTHER SAND MOULDING MACHINE HAS THE SPEED, SIMPLICITY AND STRENGTH OF THIS.

TURNS OUT BETTER MOULDS AND CASTINGS THAN BY HAND.

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Telephone, 5646 Bank. **Telegraph, "Unslipping," London.**

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PATTERN MAKER WANTED, well acquainted with marine work, cutting loam boards, and good knowledge of drawings; non-society man preferred; steady job for suitable man.—Apply Box 193, Offices of THE FOUNDRY TRADE JOURNAL, 165, Strand, W.C.

EGYPT.—First-class Commission Agents require Representations in all kinds of Hardware. Representative at present in England.—Apply Box 195, Offices of THE FOUNDRY TRADE JOURNAL, 165, Strand, W.C.

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FOR SALE, "Root's" Patent and other Foundry Blowers.
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No. 3 ,, ,, "Wilkinson's" Patent, 6 in. ,,
No. 5 ,, ,, "Thwaites" ,, 14¾ in. ,,
"Lloyd's" Patent Fan as new, 8 in. ,,
—For full details address J. LIGHT, Wolverhampton.

CASTINGS.—For Good, Sound Machinery Castings, in Green or Dry Sand or Loam, up to 15 tons in weight, and Machined if required, apply to ROSE, DOWNS, AND THOMPSON, LTD., Old Foundry, Hull. Special Quotations for Quantities.

THE well-known FINE RED MOULDING SAND, for Iron, Brass, Aluminium, &c.—Apply MANSFIELD SAND CO., LTD, Mansfield, Notts.

FOR SALE AND WANTED.—

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FIVE LATHES, length of beds 6 ft. to 27 ft.; Two Drilling Machines, One Planing Machine, One Shaping Machine, One Screwing Machine; Low Prices.—ATLANTIC WORKS COMPANY, Newport.

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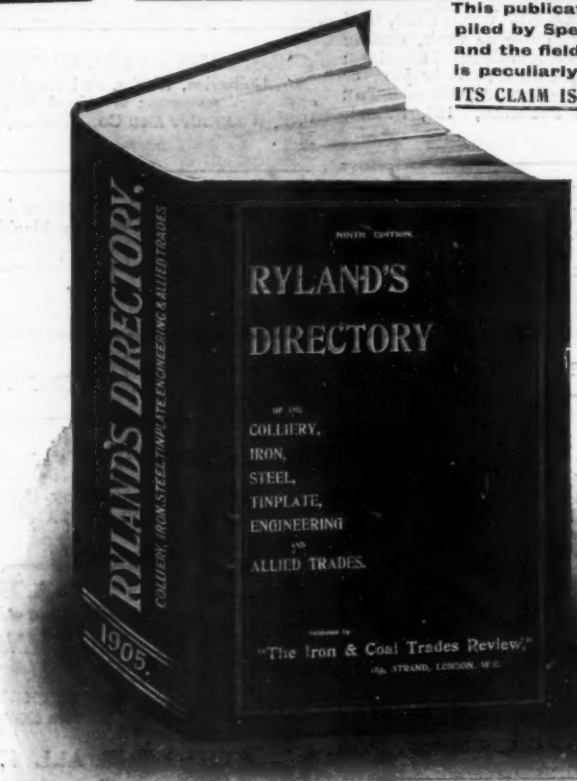

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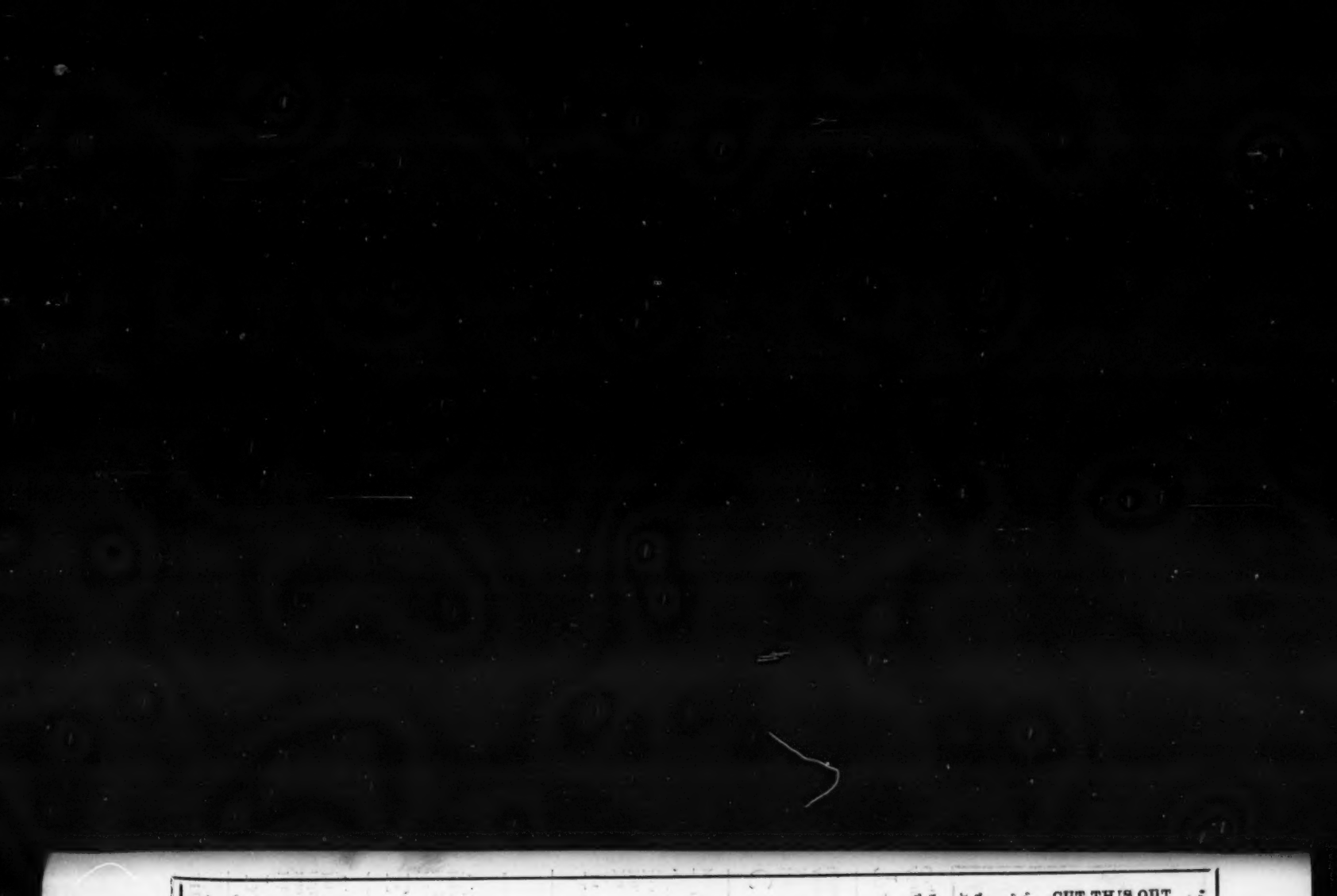
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